THE WELDING ENGINEER

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HEADS

Lukens presses and spinning machines produce heads 4 inches to over 20 feet in diameter, or as thick as 6 inches . . . in every standard style and in special shapes to meet your needs . . . ferrous, nonferrous and clad steels. Catalog No. 1 describes 3,868 standard heads. For a copy and for prices, write Lukens Steel Company, 416 Lukens Building, Coatesville, Pennsylvania.

"Head Work", a 16mm motion picture in sound and color, on spinning and pressing of Lukens Heads is available without charge. Running time: 27 minutes. Write for a booking date.

HEADS

FOUR INCHES TO OVER TWENTY FEET IN DIAMETER

• • SPEED SCRAP TO THE MILLS TO MAKE MORE STEEL • •

THE WELDING ENGINEER

ESTABLISHED 1916 DECEMBER 1948

Better Foresight

WHAT IS NEEDED today, as the numerous straws which *didn't* show the way the wind was blowing conclusively demonstrate, is better foresight. Monday morning quarterbacks can always tell us how the game should have been played, yet their sagacity only serves to point an obvious truism: hindsight is better than foresight. We have hindsight in quantities to spare; what we lack is foresight.

An uneasy peace abroad, a disturbed business-and labor situation at home, has caused all too many people to wonder if we are on the right track. Perhaps, they suggest, our system is too archaic and cumbersome for a New Era. If it could only be replaced, they sigh, by something brand-new in the way of despotism—a government that would put everyone in his proper niche and keep him there. Yet all of the ways of despotism were already incredibly ancient at the time of Nineveh and Tyre, and there never was a better regulated society than that of Cheops, for whom thousands upon thousands of slaves died under the overseer's whip to build the Great Pyramid of Gizeh. The truth is that the only really new system in the world is the one under which we Americans have grown to greatness.

When the whole world is debating the claims of rival ways of life, it becomes imperative that we understand our own. Better foresight on the American way of life is being promoted by the Advertising Council, Incorporated, in a campaign to explain the American economic system. A committee composed of all segments of American life—management, labor, religion, education and social service—has joined together on ten vital points:

"1. Freedom of the individual to work in callings and localities of his choice.

"2. Freedom of the individual to contract about his affairs.

"3. Freedom of the individual owner of property to start and manage an enterprise, to invent and profit, to invest, to buy and sell in a free market—insofar as this freedom does not conflict with the public interest.

"4. Freedom of the individual to speak, to inquire and to discuss.

"5. Protection for the individual—by public or private means—against the basic hazards of existence over which he may have no control.

"6. Government action in economic affairs when necessary to ensure national security or to undertake socially desirable projects when private interest proves inadequate to conduct them.

"7. Freest possible competition consistent with the public welfare.

"8. Free collective bargaining—the right of labor to organize and to bargain collectively with employers.

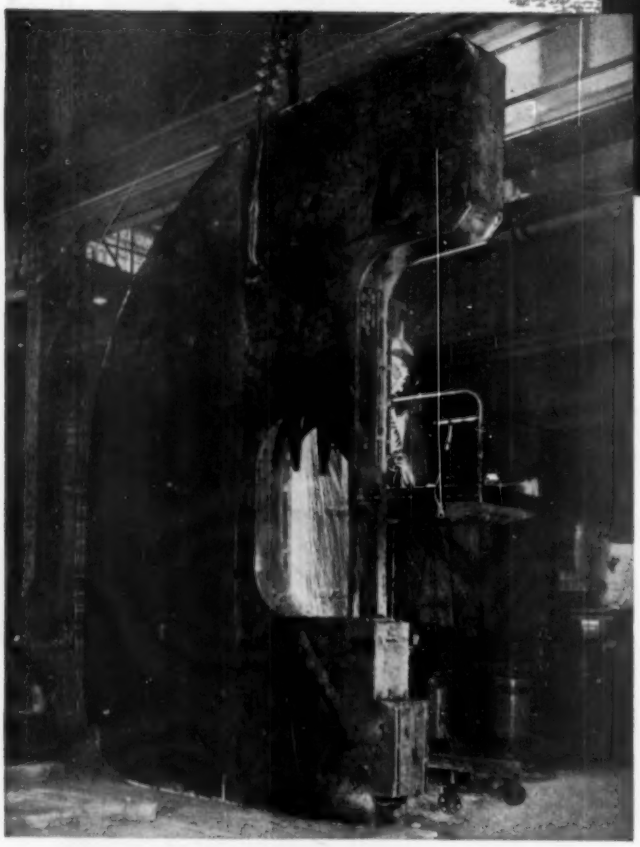
"9. Expanding productivity as a national necessity. American experience has proved that it is in the long-run interest of all: (*a*) to pay labor progressively higher wages in relation to prices; (*b*) to do this by progressively increasing productivity per man-hour through the application of constantly greater mechanization, power, efficiency and skill in the processes of production and distribution; and (*c*) to reduce hours of labor and improve real income while increasing the volume of production and distribution.

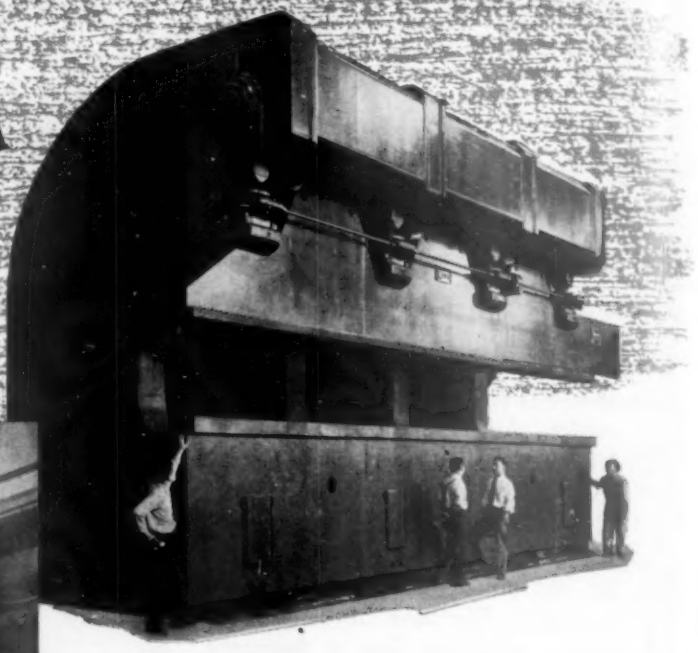
"10. Increased recognition of human values as a prerequisite to better living."

Ten points to freedom! Take the trouble to go back and reread them. Every American should know them all by heart and thank God that they are his!

WORLD'S LARGEST PRESS BRAKE

Welded with **MUREX**





In building the world's largest press brake, Warren City Manufacturing Company made sure of top quality welding by using Murex Electrodes.

This huge unit, of fully stress-relieved welded steel construction weighs more than a half million pounds without dies. It is designed to exert a pressure of over 1,000 tons for bending steel plate ⅝" thick to a right angle and in a single stroke in lengths up to 36 feet.

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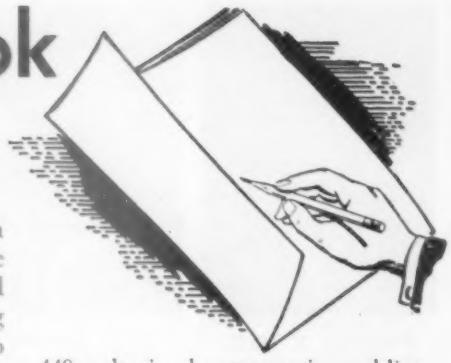
M&T ELECTRODES and GAS RODS
M&T WELDING ACCESSORIES

Convention Notebook



BY CLYDE B. CLASON

Now that the hubbub and hurly-burly of the American Welding Society's 29th annual meeting have become only a memory, it is possible to view its salient features in something approaching perspective. First of all, Philadelphia was a happy choice of convention city. The charm and historic interest of our nation's first capital provided a highly enjoyable backdrop for the convention stage.

It is gratifying to be able to report that the total registration reached 1,354, making this one of the Society's best attended conventions.

There were several surprises, including the introduction of two new processes, both ramifications of inert-gas-shielded arc welding. One of these is argon-shielded welding with a consumable electrode and the other inert-gas-shielded spot welding. More of both later on.

Metallurgy Course

A noteworthy innovation was the educational lecture series, given by Dr. R. D. Stout, associate professor of metallurgy at Lehigh University, Bethlehem, Pa. These lectures were given on Monday, Tuesday and Wednesday afternoons from 4:30 to 6:30 p.m. To attend them, it was necessary to leave the Bellevue-Stratford, where the technical and business sessions were held, and travel some twenty-odd blocks to the Convention Halls. Nevertheless, Dr. Stout's three lectures were all well attended and well received. Many who took this condensed course in the metallurgy of arc welds in steel expressed the hope that such an educational series would be made a standard part of future AWS meetings.

The 65 papers presented at the 21 technical sessions covered everything from down-to-earth problems of production, construction and maintenance to stratospheric flights of research for the long-haired intellectuals. Some of the papers in the latter category seemed a bit too highly specialized, reminding this reporter of the old wheeze defining a specialist as one who knows more and more about less and less until he ends up knowing everything about nothing. There were also too many unreadable slides of graphs and tables. When the lettering on a table of figures shows up like the Lord's prayer engraved on the head of a pin, the frustrated spectator is inclined to be irritated. This, however, is mere carping at what was, on the whole, an excellent bill-of-fare.

On its social side, the convention was beyond criticism. Beginning with the president's reception on Sunday afternoon, October 24, the visitor was caught up by a whirlwind of activities that culminated in the grand climax of the annual banquet on Thursday evening. High tribute must be paid to those responsible: S. J. Oechsle, chairman, president's reception; W. W. Barnes, chairman, dinner committee; W. F. Carson, chairman, ticket committee; Mrs. T. M. Jackson, chairman ladies' entertainment, and J. A. Cunningham, chairman of plant visitation.

Plants of the General Electric Co. and the Baldwin Locomotive Works were visited on Thursday afternoon. AWS members and guests who chose Baldwin saw heavy plate and boiler fabrication, while those who took the trip to the G-E switchgear plant witnessed some of industry's biggest resistance welders as well as some of its more delicate bench-welding operations. As a climax the visitors were taken into the high-voltage testing laboratory where, carefully shielded behind grounded screens, they were treated to an amazing display of electrical pyrotechnics in which arcs twenty and thirty feet long whipped through the air like fiery serpents. Only a million volts was needed to bring into being these spectacular phenomena. A man-made lightning flash of three million volts was also produced, and this artificial thunderbolt completely demolished the steeple of a toy edifice some forty or fifty feet away. One was left thankful that a mere 440 volts is about tops in welding.

Four days of sight-seeing were arranged for the convention ladies, including a historical tour of Philadelphia and a trip to Valley Forge.

Business Meeting

Instead of the traditional Friday afternoon session, the business meeting was held on Monday afternoon, enabling officers and directors to get away early on Friday, too. President G. N. Sieger was inducted into office, and an emblem was presented to retiring president H. O. Hill. A summary of the year's activities was made by J. G. Magrath, executive secretary, and reports were delivered on finances, membership, technical activities and research activities. Some of the highlights:

During the past year Executive Secretary Magrath visited all AWS sections at least once and made 87 calls upon various industrial plants, manufacturers and others interested in the Society's activities. He also visited nine additional communities for the purpose of exploring their possibilities for new section activity. As a result, three new sections have been officially opened: the Tri-State section at Evansville, Ind.; Anthony Wayne section at Fort Wayne, Ind., and the Nashville section at Nashville, Tenn. Other new sections or section-divisions will shortly be formed at Wilkes-Barre, Pa., Duluth, Minn., and Olean, N. Y.

Also busy during the past year, the technical committees completed two new standards and five revisions to existing standards. The new standards are: "Tentative Specifications for Copper and Copper-Alloy Metal-Arc Welding Electrodes" and "Survey of Automatic Arc and Gas Welding Processes as Used in the Automotive Industry."

The revised standards are: "Standard Welding Symbols"; "Rules for

WENDELL F. HESS
Honorary Membership

G. E. CLAUSSEN
1948 Adams Lecture

JOHN J. CROWE
Samuel W. Miller Medal

E. P. DEGARMO
Lincoln Gold Medal

FRANK G. HARKINS
First prize, RWMA

Welding Piping in Marine Construction"; "Tentative Specifications for Mild-Steel Arc-Welding Electrodes"; Tentative Specifications for Low-Alloy Steel Arc-Welding Electrodes"; "Tentative Specifications for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes."

Medals and Prizes

Awards of medals and prizes were made on Monday evening. Also conferred was a certificate of honorary membership to Dr. Wendell F. Hess, head of the department of metallurgical engineering, Rensselaer Polytechnic Institute, Troy, N. Y. Few will deny that Dr. Hess has done more than enough to deserve this honor. He is a past president of the American Welding Society, a former Adams lecturer, recipient of the Lincoln Gold Medal in 1944 and winner of many of the awards presented for resistance-welding papers.

John J. Crowe, assistant to vice-president in charge of technical relations, Air Reduction Sales Co., received the Samuel Wylie Miller Medal, awarded annually for conspicuous contributions to the advancement of the welding or cutting of metals. Mr. Crowe has published a number of papers, one of which, "Economies through the Use of High Purity Oxygen in Cutting," is generally credited with being responsible for the uniformity of high oxygen purity prevailing throughout the country today. His study on the "Effect of Tip Sizes and Pressures upon the Economy of Cutting" has helped to standardize the proper ratios for gas consumption in relation to the work. He is a past president of both the American Welding Society and the Compressed Gas Manufacturer' Association.

As the author of the paper representing the greatest contribution to the advancement and use of welding, E. Paul DeGarmo, associate professor of mechanical engineering, University of California, Berkeley, received the 1948 Lincoln Gold Medal award, sponsored by James F. Lincoln, president of The Lincoln Electric Co., Cleveland. His paper, "Tests of Various Designs of Welded Hatch Corners for Ships,"* was selected as the outstanding paper on welding for the year.

Seven authors shared the $2,000 in prizes awarded by the Resistance Welder Manufacturers Association for the papers deemed to cover significant and original achievements in the field of resistance welding. Three awards totaling $1,500 are made annually to authors in industry; two awards totaling $500 to authors in universities or colleges.

In the industrial section of the RWMA prize contest, first prize of $750 was awarded to Frank G. Harkins, welding engineer, Solar Aircraft Co., San Diego, Calif., for his paper, "Spot Welding Schedules for Nickel and Nickel Alloys."

Three engineers of the Taylor-Winfield Corp., Warren, O., took all the remaining awards in the industrial section. R. C. Jones, T-W sales engineer, won second prize of $500 with his paper, "Resistance Welding Crossed Wires." Third prize of $250 was split between C. E. Smith, chief electrical engineer, and R. H. Blair, research engineer, co-authors of the paper, "Resistance Welding Characteristics of the Dry-Disk Rectifier Welder."

In the university session, Dr. Hess and his associates at Rensselaer, Drs. W. D. Doty and W. J. Childs, made a clean sweep of the field. The $300 first prize went to Hess, Doty and Childs for their paper, "The Heat Treatment of Spot Welds in Steel Plate." Dr. Hess and Dr. Childs also won second prize of $200 for their jointly authored paper, "A Study of Projection Welding."

The A. F. Davis Undergraduate Welding Awards were presented to Alan R. Cripe, University of Cincinnati; William David McCoy, University of Minnesota, and William W. Robison, Iowa State College. Mr. Cripe won the first prize of $1,000 cash and four $250 scholarships for his university; Mr. McCoy second prize of $500 and two $250 scholarships for the university; Mr. Robison third prize of $250 and one scholarship of equal value for the university.

The 1948 Adams Lecture, "The Metallurgy of Covered Electrode Weld Metal," was ably presented by that scholar and gentleman, G. E. Claussen, metallurgist, Reid-Avery Co., Inc., Dundalk, Md. He compared analyses for different types of electrodes of the chemical constituents of the slag produced as compared to the ingredients of the electrode coating.

The Technical Sessions

A new process for welding aluminum was unveiled in a paper by Jesse S. Sohn, Air Reduction Laboratories, Murray Hill, N. J., and A. N. Kugler, technical sales division of Air Reduction Sales Co. In this process, which may be designated as inert-gas-shielded metal-arc welding, consumable wire is continuously deposited in a gaseous atmosphere. Since the Sohn-Kugler paper is abstracted elsewhere in this issue (page 54), nothing more will be said about it here.

*February, 1948, "Welding Journal."

R. C. JONES
Second prize, RWMA

C. E. SMITH
Third prize, RWMA

R. H. BLAIR
Third prize, RWMA

W. J. CHILDS
RWMA, University

W. D. DOTY
RWMA, University

Another new process, one for spot welding with the inert-gas arc, was described by Frank J. Pilia, the Linde Air Products Co. This type of spot welding offers great advantages when the joint is accessible on only one side, but it is not intended to compete with resistance spot welding under conditions favorable to the latter. It makes use of a water-cooled gun and a metal-arc transformer with a built-in high-frequency unit. Argon is employed as the shielding gas, and a tungsten electrode is used. The process is a non-pressure one, the weld being made by melting through the uppermost of the two lapped sheets until fusion is made with the lower sheet. When the trigger of the gun is depressed, it operates relays that open the argon valve and start a timing circuit for the weld; the argon shuts off automatically when the weld is completed. A light sheet can be spot welded to very heavy material by this method, so the process should have applications in cladding.

Practical aspects of the inert-gas arc welding process were discussed by A. N. Kugler, who presented a paper written jointly by him and H. A. Huff, Jr., also of Air Reduction Sales Co. Here are some of their conclusions:

D-c straight polarity with helium as the shielding gas offers the greatest heat that may be obtained by the process. The amount of heat is not so great with argon. D-c reverse polarity, the first arrangement to be used, is practically obsolete today because of the limited amount of heat developed and the excessive sizes of tungsten electrodes required. Argon is the shielding gas commonly employed with a-c welding.

An interesting paper by John W. Mortimer, Whitlock Mfg. Co., described the welding of pressure vessels of pure copper to ASME U-69 and case 934 in the ASME Unfired Pressure Vessels Code. The procedure was to use d-c straight polarity with tungsten electrode and argon shielding gas. The filler rod had to be nearly pure copper, and great difficulties were experienced in finding a rod that would give the required elongation, tensile strength and allowable working stress. The one that finally did the job was 99% pure copper with manganese and silicon additions. Back-up strips were needed because copper goes from a solid to a liquid without passing through an intermediate plastic stage. Preheating to 900—1,000 F was done with oxyacetylene torches. Copper plates up to as thick as ¾ in. were successfully welded by this method.

Production welding of stainless steel by the inert-gas method was discussed by Newton A. Blickman, co-author with Bernard Blickman, both of S. Blickman, Inc. The Blickmans use manual, semiautomatic or mechanical and fully automatic welding procedures and have devoted considerable ingenuity to the design of special jigs and fixtures. For stainless-steel alloys of the 300 series, they prefer d-c straight polarity with helium as the shielding gas. Both carbon and tungsten electrodes are used; tungsten finds its greatest application in automatic and semiautomatic welding, while carbon is best suited to manual welds or semiautomatic operations in which short lengths are joined. Carbon electrodes facilitate arc starting, are easy to handle, produce a softer arc and one readily directed. However, they are not recommended for sheets below 20-gauge thickness and must be employed with care in welding stainless steel because of the danger of graphitization.

Hard-Facing, Flame-Hardening

Inert-gas-shielded welding also found its way into the session on hard-facing and flame-hardening. H. K. Koopman, The Linde Air Products Co., told of a comprehensive series of experiments in hard-facing and surfacing with the gas-shielded arc. It was found that mild steel could be successfully hard-faced with various types of cobalt-chromium-tungsten alloys. An iron-base alloy also produced smooth deposits, and a work-hardening alloy similar to austenitic manganese steel, containing both chromium and manganese, flowed smoothly with little porosity, though a wider weave was necessary than with alloys of the cobalt-chromium-tungsten group.

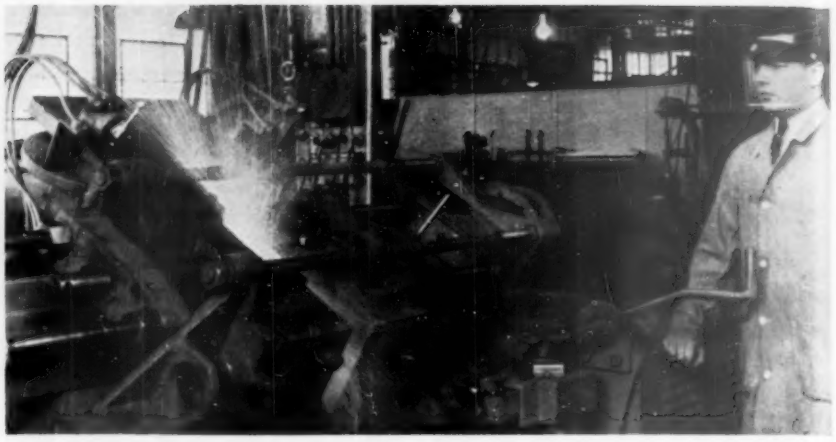
Argon was employed as the shielding gas, and both a-c high-frequency and d-c straight polarity were tested as well as both forehand and backhand techniques. In general, it was found that a backhand technique with a-c produced maximum hardness, but for most applications, and particularly for massive parts, it was best to employ forehand welding with d-c straight polarity.

Many other interesting experiments were carried out, usually successfully. These included the hard-facing of copper with cobalt-chromium-tungsten alloys, the coating of copper with silicon bronze and aluminum bronze, the coating of copper with stainless steel, the coating of mild steel with aluminum bronze, the coating of mild steel with copper (a silicon-deoxidized copper rod was best for this), the surfacing of mild steel with austenitic stainless steels, the surfacing of stainless steels with copper. D-c straight polarity with a forehand technique was the preferred

(*Continued on page 72*)

A group of steels of nickel content varying from 0.10 to 9.0% were flash welded in the laboratory. All were welded without much difficulty, once proper schedules had been established

BY J. J. RILEY
Taylor-Winfield Corp.



FLASHING BEGAN at high voltage under manual control of platen. Properly started, flashing continued under automatic control at lower voltage

Flash Welding N

Low-alloy steels in which nickel is a prominent element can be flash welded with excellent results, a laboratory investigation proves. However, it is necessary to observe special precautions not required for low-carbon steels.

Materials and Equipment

A group of steels containing different nickel contents was selected. A nickel variation of from 9.0 to 0.10% was covered. In addition to the 9% nickel steel, SAE 2320, SAE 3115, SAE 4615, SAE 4640 and NE 8630 steels were welded. To establish a yardstick for flash-welding technique and physical properties, a plain-carbon steel, SAE 1030, was also welded.

All of the above steels except the 9% nickel were welded in the form of bars, rolled or turned down to 1-in. diameter. The 9% nickel composition was welded as tubes of 2-in. OD and 0.134-in. wall thickness.

Welding Technique

Welding was done on an RWMA size 5 hydraulically operated flash welder equipped with the latest type of hydraulic control, affording a combination of manual followed by automatic control of the movable platen. In addition, electric welding control functioned to allow two values of welding voltage during the welding cycle, the starting level being in general higher than the level used during the latter and major portion of the cycle. The inherent flexibility of the equipment made it relatively easy to obtain good welding results.

Initial work indicated that a comparatively high level of energy input resulted in better welds. In most cases, it was necessary to start flashing by using a higher value of welding voltage coupled with manual control of the welder platen. Manual control allowed the platen to be reversed one or more times until flashing could be easily established. Once flashing was properly begun, the welding cycle was controlled automatically to insure consistent results. A short automatic flashing time and a low but adequate voltage are characteristic of all welding schedules.

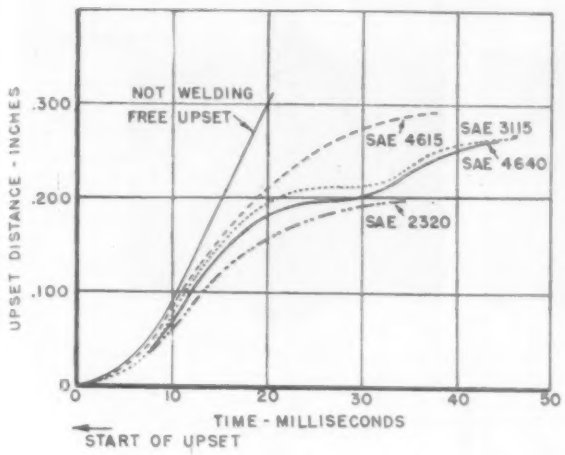
Recording instruments measuring primary voltage, secondary voltage, primary current and platen motion were used to judge duplication of welder performance. A special hydraulic oil pressure recorder to measure hydraulic transients enabled the consistency of hydraulic performance to be checked.

In welding a series of steels, it is desirable to measure some factor which clearly indicates the differences between them. Measurement of platen motion during the upsetting or forging period was selected as the above criterion. Tests indicated that the force applied to the platen was constant during the upsetting period. Consequently, motion of the platen should indicate indirectly the plasticity of the weld zone immediately prior to final consummation of the weld. These measurements were made by gearing a resistive potentiometer to the welder platen and recording the voltage changes on an oscillograph. The oscillographic data replotted are shown in Fig. 1, and the welding schedules which produced the best results are summarized in Table I.

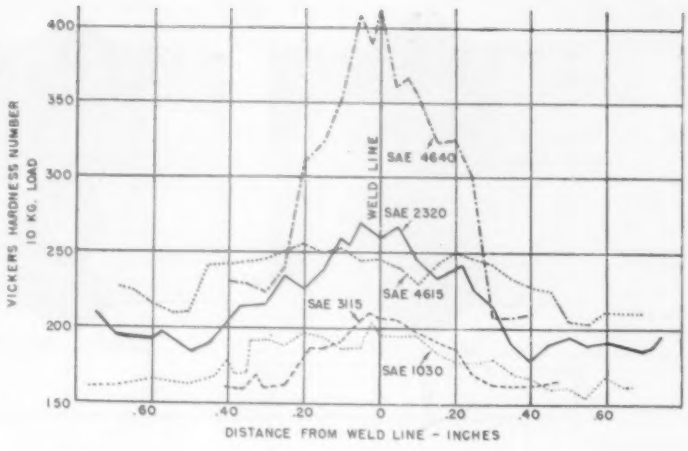
Testing Technique

The formulating of a weld schedule by cut-and-try experimental procedure goes more rapidly if even a crude testing technique can be devised. A preliminary test which would start fracture in the weld line was used. Visual examination of the weld plane for absence of weld discontinuities was judged more useful than actual quantitative values for preliminary work. To cause fracture in at least part of the weld plane, the welded specimens were prepared by grinding off the upset material and then notching the specimens at the weld line with a hack saw for a depth of $\frac{1}{8}$ to $\frac{3}{16}$ in. The specimens were then loaded under a hydraulic ram, with the weld at the maximum stress point, until fracture.

In a poor weld, fracture occurred along the weld line, and the discontinuity of weld-line structure was obvious. In a good weld, fracture extended into the weld plane for a short distance below the notch and



1—PLATEN TRAVEL during the upsetting action. The upset distance is plotted against time



2—HARDNESSES in as-welded condition of flash welds in 1-in.-diameter bars of five of the seven steels investigated

g Nickel Steels

then along the fibers away from the weld plane and into the parent metal. Only in the more air-hardenable steels such as SAE 4640 would a good weld fracture entirely across the weld plane. This rough check, later verified by more refined quantitative tests, proved surprisingly indicative of good welds.

Welded specimens were subjected to two types of heat treatment. The first was primarily a stress relief, and the second a complete treatment consisting of normalize, heat, quench and temper cycle. The details of these treatments are listed in Table II. After heat treatment, the welded specimens were machined as regular tensile test bars, of 0.505-in. diameter, and tensile tested. Hardness surveys were made on all as-welded specimens.

Test Results

The physical properties of welds under tensile loading are given in Table II, and hardnesses of different steels in the as-welded condition are plotted in Fig. 2. Photomacrographs appear in Fig. 3 of welds in NE 8630 in the three conditions: as-welded, stress-relieved and heat-treated. Hardness surveys are given for the first two conditions. These photomacrographs are typical of the other steels investigated.

All welding schedules are similar

Table I. Welding Schedule for Seven Types of Steel

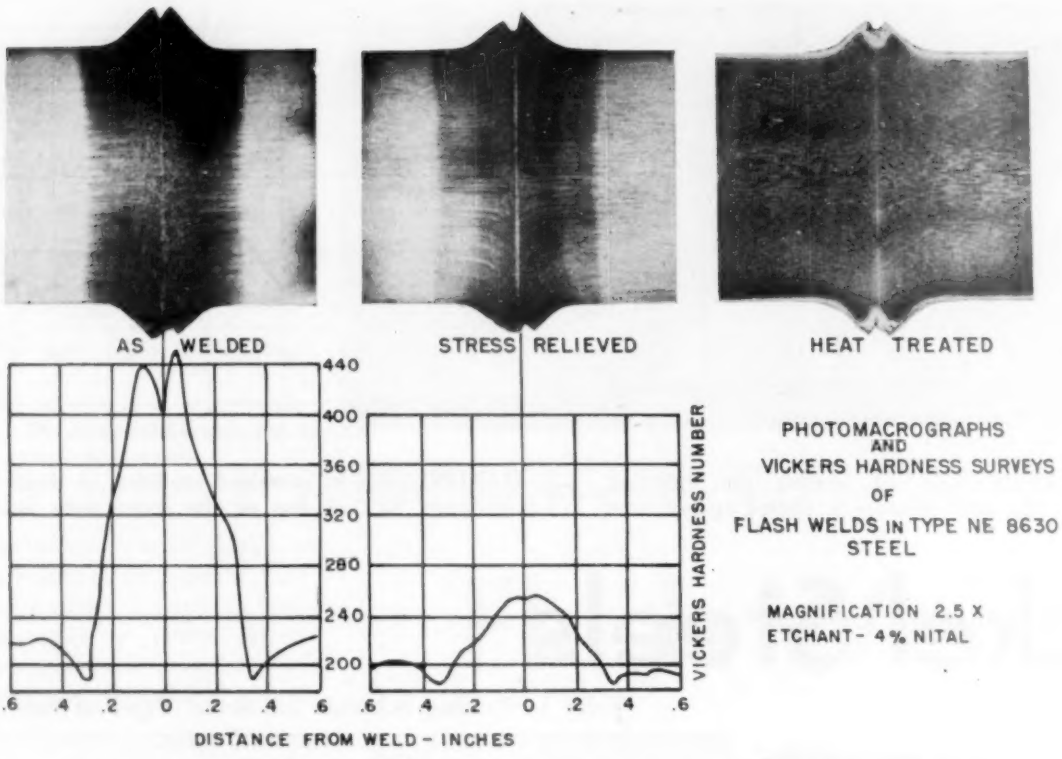
	SAE 2320	SAE 3115	SAE 4615	SAE 4640	NE 8630	9% Nickel	SAE 1030
High secondary voltage, open circuit (volts)	5.24	5.42	5.32	5.42	5.27	5.23	5.9
Low secondary voltage, open circuits (volts)	4.58	5.42	5.32	5.42	4.07	4.6	5.9
Secondary current[1] flashing (kiloamperes)	2.00	2.4	2.46	2.4	1.28	2.2	2.94
Secondary current upsetting (kiloamperes)	18.6	20.9	21.2	20.9	16.4	22.0	22.0
Manual flash-off time (h-v) (seconds)	12	8.2	17	8.4	20	5.0	10.4
Automatic flash-off[2] time (h-v) (seconds)	4.0	6.0	5.2	6.0	7.0	9.6	6.8
Automatic flash-off[3] time (l-v) (seconds)	2.0	None	None	None	8.0	3.0	None
Upset current flow[4] time (l-v) (cycles)	69	60	69	60	40	6	84
Initial die opening (in.)	1.88	1.93	1.93	1.93	1.76	1.56	1.93
Manual flash-off (in.)	.16	.13	.13	.13	.09	.06	.13
Automatic flash-off (in.)	.52	.52	.52	.52	.51	.69	.52
Upset (inches)	.20	.28	.28	.28	.16	.25	.28
Total material lost (in.)	.88	.93	.93	.93	.76	1.00	.93
Final die opening (in.)	1.00	1.00	1.00	1.00	1.00	.56	1.00
Flash-off cam	C-37707	C-35323	C-37707	C-35323	C-37707	C-25322	C-35323

NOTES: [1]This is an average value during low-voltage portion of cycle. It may vary approximately 200% for very short intervals.

[2]Time of automatic portion of cycle in which the higher value of welding voltage is applied. If only a single value of voltage was used for welding, its time is indicated in this column.

[3]Same as above except low welding voltage applied.

[4]Cycles of time based on frequency of 60 cycles per second.



3—PHOTOMACROGRAPHS of flash welds in NE 8630 steel in as-welded, stress-relieved and heat-treated conditions. Hardness curves are plo.ted for as-welded and heat-treated conditions

except for the manual flash-off time and upset dimension. The manual time indicates the degree of difficulty in starting the workpieces to flashing. While the period is somewhat long compared to the automatic flash-off time, only a small quantity of metal was flashed away manually. Consequently, only a small fraction of the total heat was accumulated during manual flashing. Had the workpieces been beveled previous to welding, the manual flash-off time could have been reduced.

The upset dimension was made large enough to make certain the weld would be free of impurities and cast metal.

All of the test steels flash welded satisfactorily, and all specimens in the stress-relieved condition failed remote from the weld line beyond the heat-affected zone. Some of the completely heat-treated specimens failed in the heat-affected zone and some failed diagonally across the weld. However, these fractures evidenced unusually good ductility for this type of failure, indicating a good weld.

Hardness surveys of the as-welded condition indicate a rather low level except in SAE 4640 steel. The actual level is a function of the degree of air hardenability and the quench rate in the welder. The upsetting current was left on for a relatively long interval of time to store up as much heat in the weld as possible. Thus, the weld cooled as slowly as it could be expected to cool in air, eliminating the danger of welds cracking on cooling immediately after welding.

All steels evidently had approximately the same degree of plasticity at the time of welding.

Conclusions on Weldability

The ability to arrive at a satisfactory welding schedule through cut-and-try procedure and the ability to duplicate the results of a particular schedule provide a yardstick for weldability. On this basis, SAE 2320 and 3115 were hardest to weld, being sensitive to the length of automatic flashing time and level of energy input. SAE 4640 and 4615 were less difficult, but precautions had to be exercised to prevent 4640 from hardening excessively in the as-welded condition. NE 8630 was not sensitive to wide variations in welding variables and was as easy to weld as the medium-carbon steel SAE 1030 selected as a control.

It is the writer's opinion that the starting of the flashing cycle by manual control, followed by automatic control, is of prime importance for good results in such steels as SAE 2320, 3115, 4640 and 4615. This procedure enables a low level of welding voltage during the automatic flashing cycle without starting difficulties. Low welding voltage during the major portion of the cycle prevents excessively deep craters from forming on the flashing surfaces. Consequently, the flashing or mating surfaces are smoother physically and the variation in depth of the plastic zone across the flashing surfaces is less immediately prior to forging or upsetting. Thus, the best welding conditions are present, which seems a necessity for the making of welds possessing the ultimate tensile strength of the steels.

The author acknowledges, with thanks, the co-operation of the laboratory staff of the Taylor-Winfield Corp. and of the International Nickel Company, Inc., which financed the work and offered advice on the procedure. The Babcock and Wilcox Tube Co. performed the physicial testing of the tubular sections.

Table II. Physical Characteristics of Flash Welds

SAE 2320

Yield Strength, Psi	Ultimate Strength, Psi	Elongation in 2", Per Cent	Location of Fracture
Stress relieved at 1,150 F for 3 hr—slow cool			
	85,000	23.4	1" from weld
	84,000	25.0	½" from weld
	83,600	25.0	1" from weld
Normalize at 1,650 F—air cool—heat 1,550 F—water quench—temper at 1,200 F—slow cool			
	102,250	19.0	1" from weld
	100,900	28.0	1" from weld
	104,800	25.0	1" from weld

SAE 3115

Stress relieved at 1,150 F for 3 hr—slow cool			
47,800	68,200	32.8	13/16" from weld
47,300	70,000	32.8	1" from weld
48,450	69,800	32.8	1" from weld
Normalize at 1,650 F—air cool—heat 1,550 F—water quench—temper at 1,200 F—slow cool			
65,800	81,900	31.2	Diagonally across weld
64,900	77,800	27.2	"
66,350	76,200	21.8	"
As-welded			
48,300	73,900	25	13/16" from weld

NE 8630

Stress relieved at 1,150 F for 3 hr—slow cool			
75,000	90,000	22	1" from weld
71,000	87,500	24	1" from weld
72,200	87,800	22	1" from weld
Normalize at 1,650 F—air cool—heat 1,550 F—water quench—temper at 1,200 F			
104,800	115,200	24.5	3/16" from weld
104,500	115,000	20.0	In weld
101,800	112,300	22.0	Diagonally across weld

SAE 1030

Stress relieved at 1,150 F for 3 hr—slow cool			
42,250	76,600	28.1	¾" from weld
40,800	76,100	26.6	¾" from weld
38,450	75,400	26.6	¾" from weld
Normalize at 1,650 F—air cool—heat 1,550 F—water quench—temper at 1,200 F			
59,620	82,180	27.3	Diagonally across weld
64,400	82,180	27.3	"
58,180	81,680	21.8	"

SAE 4615

Stress relieved at 1,150 F for 3 hr—slow cool			
73,400	86,800	23	1" from weld
73,180	86,590	24	1" from weld
73,950	86,600	24	1" from weld
Normalize at 1,650 F—air cool—heat 1,550 F—water quench—temper at 1,200 F—slow cool			
	101,200	24	1" from weld
91,100	101,600	25	3/16" from weld
89,600	99,180	19	Diagonally across weld

SAE 4640

Stress relieved at 1,150 F for 3 hr—slow cool			
69,500	100,500	16	Remote from weld
72,600	101,500	16	Remote from weld
Normalize at 1,650 F—air cool—heat 1,525 F—oil quench—temper at 1,150 F—air cool			
117,500	129,500	23	Adjacent to weld
120,500	130,500	17	At weld
As-welded			
83,000	112,500	14	Remote from weld

9% Nickel Steel

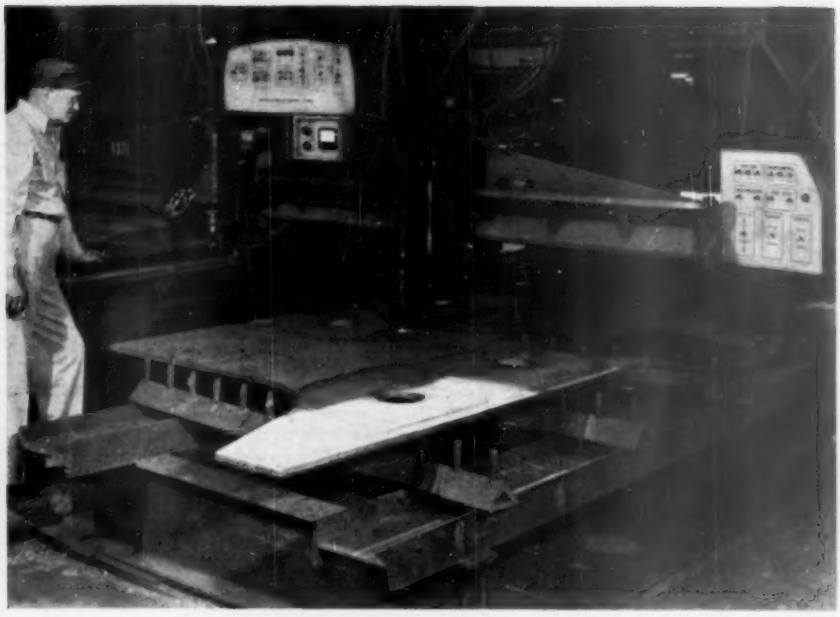
Stress relieved at 1,050 F for 2 hr—air cool			
112,200	122,250	16	Remote from weld
115,900	122,300	19	Remote from weld
119,500	117,200	16	Remote from weld
119,700	119,950	19	Remote from weld
Stress relieved at 1,050 F for 2 hr—water quenched			
113,600	116,800	18	Remote from weld
121,000	127,250	18	Remote from weld
117,500	125,700	27	Remote from weld

NOTES: Tensile test strips were cut from tube, two strips from each tube. Strips approximately 1" wide.

All fractures outside the heat-affected zone.

Above results taken from article, "New 9% Nickel-Steel Tubing—Properties and Processing," by H. D. Newell, J. A. Manfre and M. A. Cordovi—*Materials and Methods*, January, 1947.

1—AUTOMATIC WELDING joins liner to 54-in. brake rim of drilling rig. Work revolves on table



2—MULTIPLE FLAME-CUTTING of plate may be performed on this dual-control template-following machine. Parts shown were cut from ⅞-in. steel. Plate up to 5 in. thick can be cut if such heavy cutting is necessary

Unusual Jobs

High-tensile alloy steel is welded on a production basis by means of a fixture that is really an electric furnace

BY FRED M. BURT

As large as many a complete factory is the 65,000-sq-ft welding shop of The National Supply Co. at Torrance, Calif. National Supply manufactures a line of oil-field equipment including Diesel and gasoline engines, drilling rigs, casing, drill pipe, line pipe and tubing. Its several divisions operate other plants at Springfield and Toledo, O., Houston, Tex., Ambridge and Etna, Pa.

Highly Integrated Plant

The new Torrance plant occupies a 38-acre site south of Los Angeles and includes 31 principal buildings with 659,000 sq ft of floor space. Besides the extensive welding areas, steel storage yards, assembly floor, steel melting department, foundry, cleaning and chipping department, pattern shop, laboratories, administrative and engineering departments, machine shop, warehouses, receiving and stores departments, heat-treating, flame-hardening, plating and forging departments unite to comprise what is probably the most highly integrated heavy manufacturing plant on the Pacific Coast.

The diversified and heavily equipped welding shop, under supervision of David O. Chase, partakes of the same spacious scale and completeness characteristic of the plant as a whole. Its equipment includes: 54 arc welders of 150 to 750 amp capacity; ten positioners; one shear, ⅜ by 96 in. capacity; one bending brake, ⅜ by 100 in. capacity; two bending rolls, up to 1 by 96 in. capacity; a hidden-arc automatic welding machine of 1,200-amp capacity (Fig. 1) and three flame-cutting machines. One of the latter (Fig. 2) is a large dual-control machine which follows a template to cut multiple parts from steel plates up to 18 by 7 ft. This machine is able to cut through 5 in. of steel if such unusually heavy cutting becomes necessary. Supplementing it are a pantograph-type machine, which may be operated by either hand or magnetic tracing, and a production flame-cutting machine operated by a magnetic tracer.

In the heat-treating department are four flame-hardening machines (Fig. 3) for the hardening of sprockets, gears, pinions, bearing surfaces and race rings.

Oxygen in Trailers

To supply about 50 outlets in the welding shop and dozens of others scattered throughout the plant in departments where oxyacetylene welding and other flame processes are done, oxygen is brought to the plant in trailers. The tanks of one trailer have a total capacity of 33,000 cu ft of oxygen, which is piped to the chipping department (for flame-cutting), to the scrap yard (for flame-cutting), to the welding shop (for flame-cutting and welding) and to the heat-treating department (for flame-hardening).

Acetylene is produced from carbide in a separate building housing

3—FLAME-HARDENING teeth of spiral gear for a rotary drilling rig (center background). Torches oscillate on each side of tooth. At left, sprocket is in position on a spinner table for hardening of inside diameter

Done Daily

generators and is piped to all of the above-mentioned departments except flame-hardening, which uses natural gas.

Main Welding Area

The main welding floor, 360 ft long by 50 ft wide, is spanned for its entire width by a 15-ton overhead crane. Another 50-ft craneway allows a 7½-ton crane to serve the adjacent steel yard and prefabrication areas. Component parts and subassemblies follow clean, straight lines of flow from stock storage to flame-cutting and welding, through finishing and inspection operations.

Heaviest and largest quantity production job in the welding shop is the assembly and welding of heavy bases for oil-field equipment. National Supply now manufactures rigs in which the draw works can lift a string of casing extending to the bottom of a 20,000-ft oil well. Going down into the earth for nearly four miles, such a string of casing may weigh as much as a million pounds. It goes without saying that a very heavy and strong base construction is required for the rig.

Besides the welded construction of heavy base frame members and plates, a large amount of welding is done on the many guards that encase the moving parts of the equipment. Guard production parallels the progressive movement of the frame construction, the guards and frames finally coming together for fitting in the guard fitting area.

The 60-ft-wide area housing the guard fabrication, layout tables and other operation is served by two parallel craneways, each spanned by four I-beam cranes carrying ½-ton hoists. Two adjacent areas at an end of the welding shop are used for arc and oxyacetylene welding for the maintenance department and for the safety guards that are used throughout the plant.

As might be expected in such a highly integrated plant, the welding shop is called upon for assistance in every sort of construction, large and small. This even includes the erection of new buildings. With the extensive facilities available and a force of 150 workers for two 8-hr shifts, it is hard to imagine any welding job that cannot be handled with efficiency and dispatch. Annual electrode consumption of close to 100 tons indicates the welding volume.

Oil wells and aircraft aren't too far apart at Torrance. One of the company's most interesting production jobs is the landing gear fitting for the Consolidated B-36 six-engine bomber, the world's largest land plane. Each bomber has four such fittings, purpose of which is to connect the landing gear to the wing (Fig. 4).

Manufacture of the fittings begins in the company's new 25-ton electric furnace, from which high-tensile alloy steel is poured into an ingot mold. The ingot is forged into a billet and then machined with special equipment in the machine shop.

A landing-gear fitting is composed of a central section, two spar plates and two tabs (Fig. 5). After finish machining has been completed, the five parts are mounted in a jig for tack welding. Ten or more tacks are made. The assembled fitting goes to inspection to be checked in a master fixture for exact alignment.

Welding in a Furnace

If the tacked fitting is found to be O.K., it is placed in an adjustable, articulated electric furnace to be arc welded. The furnace welding fixture (Fig. 6) was principally developed by Supervisor Chase and is one of the many items of specialized equipment designed and built entirely within the Torrance plant. It is used primarily to weld high-tensile alloy steels or other critical materials, and it performs three tasks at once:

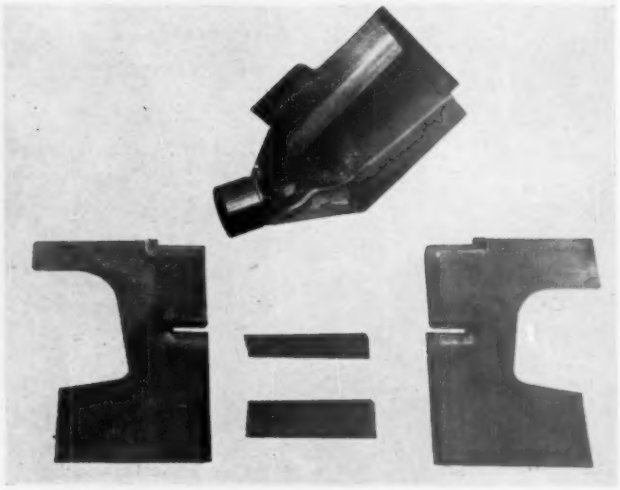
(1) It forms a jig for complicated assemblies; (2) it preheats the work evenly—without developing those uneven heat stresses which cause later cracking or deformation; (3) it holds work at the correct temperature all through the welding operation.

To provide the "even" heat distribution mentioned under Job 2, the thin sections of the fitting must be "papered off"; *i.e.*, covered on both sides with 1/16-in. asbestos sheets coated with refractory cement.

In Fig. 6, note that the weldor's right foot is resting on a pedal. With both hands entirely free for welding, he can adjust the current with his foot to compensate for varying metal thicknesses or different weld-

Tale of a Fitting

4—LANDING-GEAR fitting installed in wing buck jigs. These welded fittings are used on the B-36 six-engine bomber to connect the landing gear to the wing



5—FIVE COMPONENTS of fitting before assembly. Central section above; two spar plates on each side of the two tabs. These parts will be tack welded in a jig.

ing positions. Craters can be eliminated by "snuffing out" the current as the weld is completed. Secret of these useful accomplishments is a variable resistance operated by the foot pedal and designed to vary the excitation current of a d-c welding generator so that the operator can regulate the generator output from full rated capacity down to zero without varying the arc distance or changing the setting of the machine.

The welded fitting (Fig. 7) is examined in a 250,000-volt X-ray machine (Figs. 8 and 9). If welds are found satisfactory, the fitting is annealed in an electric furnace equipped with a recorder-controller unit. To prevent oxidation, the annealing is done in a controlled atmosphere. Subsequently, the fitting is quenched and drawn to a tensile strength of 170,000 psi.

Sandblasting and Inspection

There are two sandblasting chambers side by side in the welding shop, both outside operated, in which this finishing operation can be done. Sandblasting is followed by magnetic-particle inspection to detect surface cracks and other discontinuities that are not too deep-seated. The welding department operates a 10-ft machine for magnetic-particle inspection; the machine departments have eight other inspection units of 6-ft and 8-ft sizes and one portable. After magnetic-particle inspection, the fittings are checked again in the master fixture.

Magnetic inspection is supplemented by X-ray inspection to discover subsurface cracks, inclusions, porosity and other flaws. We have already mentioned the examination given before annealing under the 250,000-volt X-ray machine. After heat-treating and inspection operations at Torrance, the fittings are sent to Triplett & Barton, Burbank, Calif., to be given an Army-certified inspection under a 1,000,000-volt X-ray machine. Returned to Torrance, the fittings are given their final Army inspection and shipped. First, however, it is necessary to cut off the manufacturing tabs and thread the boss of each fitting (Fig. 7).

Automatic Welding

No discussion of the Torrance welding shop would be complete without mention of its automatic welding equipment. The 1,200-amp machine is being used in Fig. 1 to weld a 54-in.-diam brake rim; a ¼-in. liner is welded to 1½-in. plate in one pass. Besides brake rims varying in diameter from 54 to 62 in., the equipment is also used to weld the two halves of cable drums together and to weld wash pipes, sprockets and other units. Table of the positioner on which the brake rim is mounted is rotated and tilted by hydraulic cylinders. Speed of rotation is variable from a barely noticeable movement up to 4 rpm. The welding head is mounted at the end of a 6-ft arm, which gives it a 4-ft vertical lift and a swing of nearly 300 deg.

A device giving a stroke of up to 6 ft is used instead of the rotating positioner when straight-line welds are made with the automatic head.

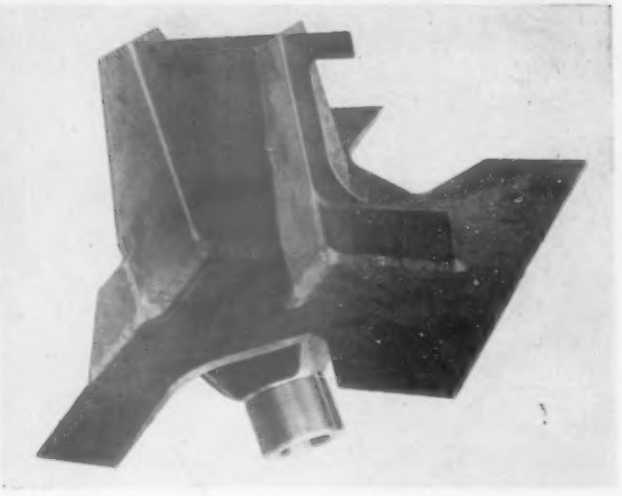
As comment on the plant's manufacturing facilities, we cannot do better than quote from an illustrated booklet recently issued to all Torrance employees:

"Due to Army and Navy wartime requirements, new welding techniques and new equipment were developed right in this shop. Today, our crews of certified weldors make controlled precision welds in gun steel and high-tensile alloy steels—and make them with tolerances considered acceptable in good machine shop work. Facilities are available here for X-ray and magnetic inspection, one reason why the Army and Navy continue to call on us for precision welding."

Flame-Hardening

Teeth of big bevel gears and pinion gears are flame-hardened to exact specifications. In Fig. 3 we see one of the four flame-hardening machines (center background) being used to harden the teeth of a spi-

6—ELECTRIC FURNACE fixture for welding high-tensile steel at correct temperature. Arc control on which weldor's foot rests frees both his hands for welding



7—WELDED FITTING after heat treatment, sand-blasting, X-ray and magnetic-particle inspection. One of the last manufacturing steps was to thread the boss

rally cut bevel gear. The two torches oscillate back and forth on each side of a gear tooth to apply the heat for a period of 15 seconds. After this set time, the flame jets automatically rise, and the operator moves a hand lever to index the table and gear a distance of three teeth. This action places the tooth just heated under a water quench, where it is held for the same 15 seconds that it takes to heat the next tooth. The cycles continue until all of the teeth have been hardened.

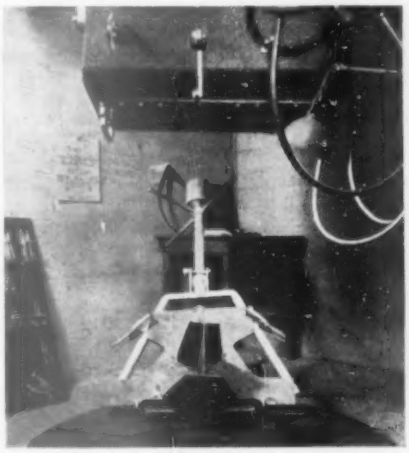
Another application is on the rotary table of a drilling rig, where four vertical inside bearing surfaces, 8 by 4 in. at 90-deg angles to each other, must be flame-hardened to a $\frac{3}{32}$-in. depth. The rig rotary table rests on a revolvable work-holding table mounted on an air-operated ram for raising and lowering. The work-holding table is submersible in a large cylindrical water tank.

The operator applies the flame to the first bearing surface area with a multiple-flame torch shaped like a horizontal slot 8-in. long. He starts at the bottom of the 8-in. width and moves up slowly for the 4-in. vertical travel. Just below the torch flames is a parallel row of water jets, which start an intermediate quenching. After completion of the heating, the ram drops to "dunk" the entire table for its final quenching and hardening. The table is then raised and rotated for the next bearing surface.

Several disc torches of from 2 to 11¼ in. diameter are used for flame-hardening inside diameters. The work is so positioned that when the disc torch moves upwards at about ¼ in. ipm, the whole inside diameter is progressively heated and quenched. The brass disc torch has fuel gas, oxygen, air and water connections. The flames come out of a circular slot at the top, just below which are closely spaced jets emitting compressed air to promote combustion in the confined space. Below the air jets are the jets of quenching water.

Outside diameters are flame-hardened in a somewhat similar manner with ring torches of from 2 to 10 in. ID. The air jets are not necessary with these torches as combustion is not confined. Bearing or ring races are flame-hardened with special torches as they are turned past the torch on a "spinner" (revolving table). At the left of Fig. 3, the inside diameter of a sprocket is in position for flame-hardening on a spinner.

The writer would like to acknowledge his indebtedness to Supervisor David O. Chase and Technician George Robinson for their fine assistance and information provided, to Works Manager J. D. Spalding for his good co-operation and to Advertising Manager J. H. Larrimer for the pictures and additional data.



8—250,000-VOLT X-ray machine checks the welds. Fitting is examined in a concrete-walled room

9—CONTROL PANEL. X-ray machine operates by remote control after fitting has been positioned

1—SIMPLE HOLDING DEVICE. The X-shaped hold-down clamp is fastened by a large wing nut. Holes in the corners help to insure full penetration

Jigging for Better Welds

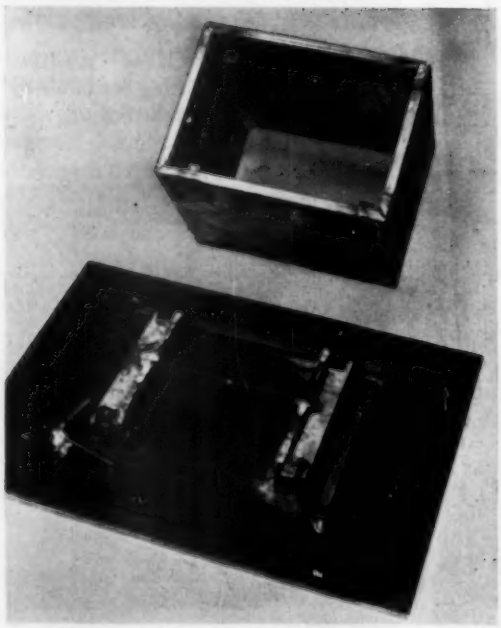
BY PHIL GLANZER

Should the jig help to prevent distortion? Is positioning necessary? What can be done to secure rapid, accurate alignment? These and other questions must be answered to determine what type of jig should be selected

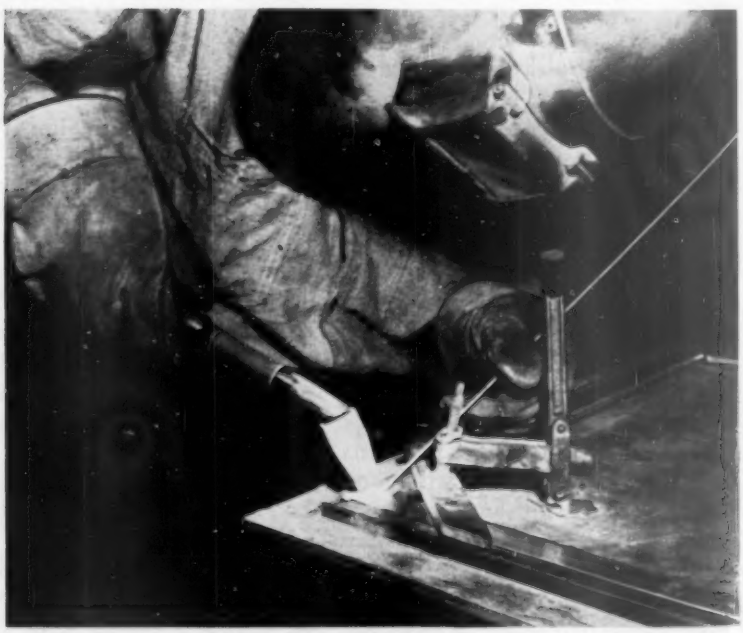
IN EVERY welding operation, some means for holding the work must be provided to obtain satisfactory results. The operator, in effect, uses some form of jig for welding whether he simply lays the parts on the surface of a welding table, props them in position with firebricks, clamps them to the tabletop or sets them up in an elaborate work-holding device. Without such aids, repair and production welding operations might not be possible. With them, jobs are made easier, and better welding results are generally obtained.

Purpose of Jigs

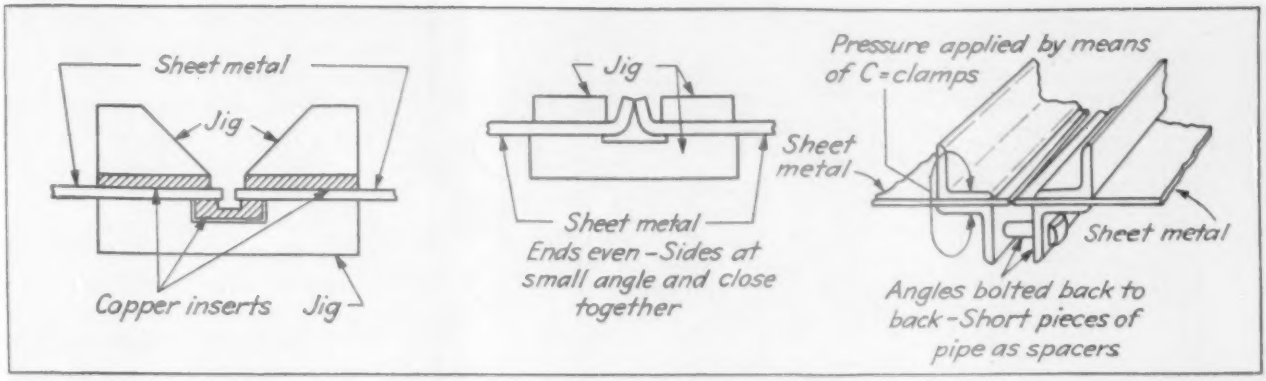
Regardless of design or usage, the principal purpose of any welding jig is to make it easy for the operator to obtain good results. Which type of jigging is satisfactory for a given job



2—NEXT STEP is to secure alignment. Here H-shaped member holds lugs in position for welding inside rectangular shell



3—QUICK-ACTING toggle clamp in this fixture insures rapid release of magnesium screen frames welded by the inert-gas-shielded arc process. Guides of bar stock are provided in order to align the parts



4—BULK IN HOLDING JAWS and easy access for welding are afforded by these three types of bar clamps

will depend upon the nature of the work and the metal to be welded.

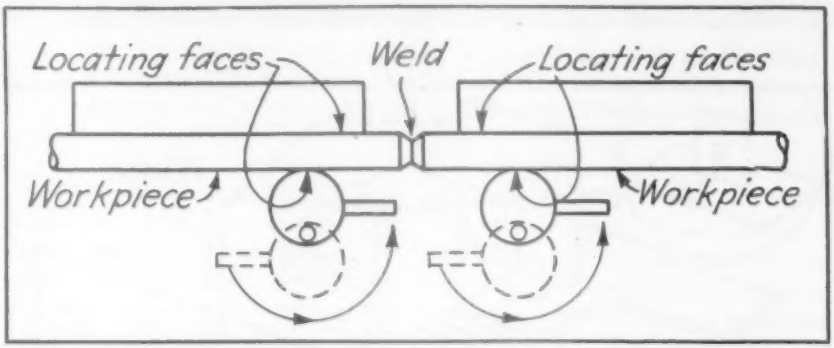
Some operations, such as Fig. 1, may require only that the parts be held in correct relative positions until they are secured by welding. For more difficult work, additional demands must be satisfied. Often a jig must also act as a gauge in spacing the parts to assure accuracy of alignment and size in the finished assembly (Fig. 2). Such a jig frequently eliminates fitting and complicated setting-up, and hence the task of assembling the members for welding is greatly simplified.

Jigs for welding light-gauge material help to make this type of work easier through control of warping and edge movements by absorbing heat, by equalizing heat effects or by forcibly restraining or directing the forces of expansion and contraction. Some non-ferrous metals, such as aluminum, require a jig that will back up the material and provide adequate support to prevent collapse of the metal at elevated temperatures. So that failure will not result in the heat-weakened metal, a jig of this type usually needs a device for rapid release of the restraining forces immediately upon completion of the weld. A toggle clamp is one such device (Fig. 3).

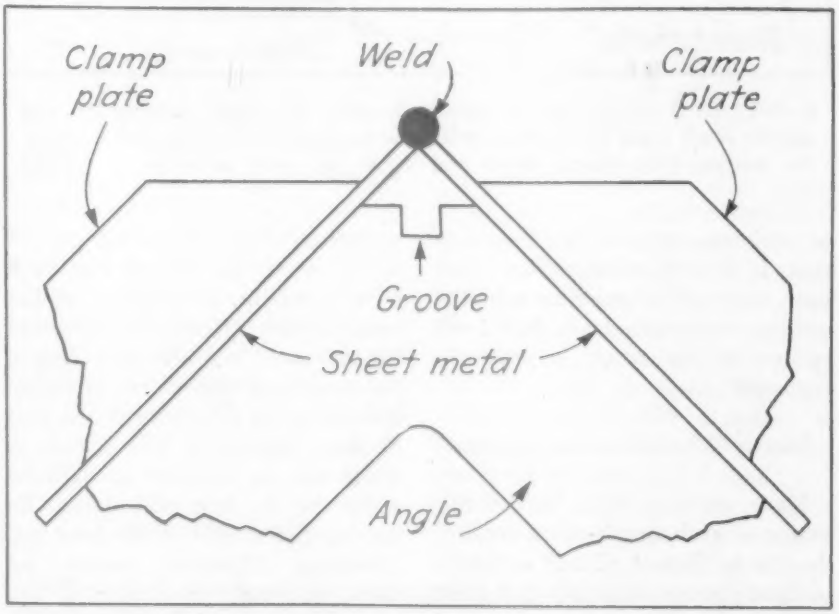
Another common purpose of jigs is to make handling of the work convenient. Jigs can hold parts in alignment, give free access to the weld areas, enable the operator to turn the assembly so he can work continuously in the most convenient position.

With assembly of parts, alignment and support, allowances for expansion and contraction all handled by the jig, the weldor is able to devote his full attention to proper welding technique and thereby obtain both increased welding speed and improved quality.

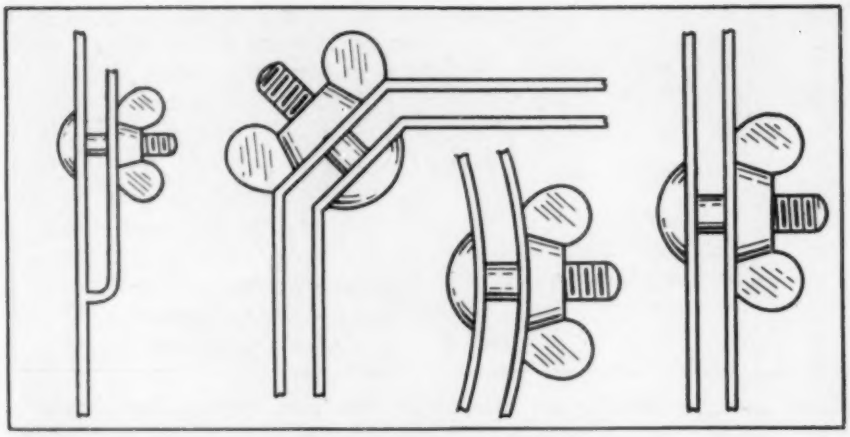
A jig may be simple or elaborate, but to be wholly satisfactory it must be designed to fill the specific needs of the particular operation, with little or no thought given to cost. Obviously, such a tailored jig is practical only for mass production. When operations are not repetitious, a costly jig will not be justified unless maximum accuracy is absolutely essential. Simple work-holding devices can generally be used for odd jobs



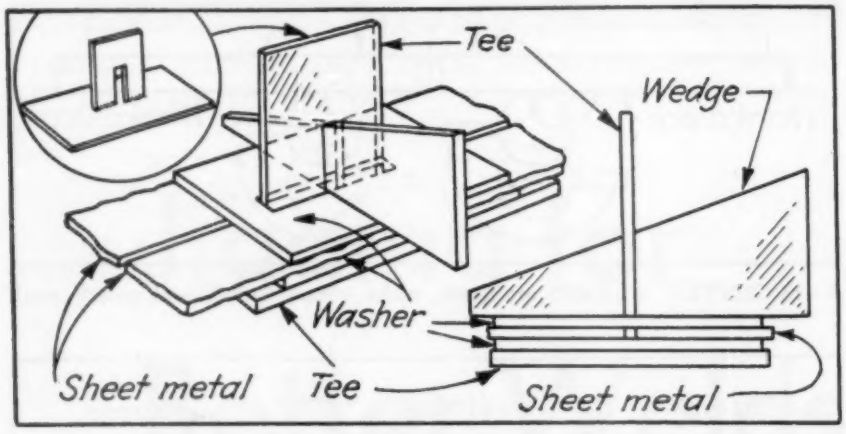
5—ECCENTRIC CLAMPS are quick, make it easy to lock and unlock work



6—GROOVED ANGLE for backing of the joint to insure deeper penetration in square-corner welds. This groove is ⅛ in. wide by 3/16 in. deep



7—H-CLAMP varieties. Jaws are bent to conform to the work contour, a valuable feature in holding tank shells and other cylindrical objects



8—WEDGED H-CLAMP or double L-clamp is simple, inexpensive and may be easily made from scrap stock. The wedge is driven into slot to clamp the washers (flat plates) above and below the sheet metal to be welded

of maintenance and small production. It is with these devices—and how they can be used to help the welding operator obtain better results—that this article is primarily concerned.

Simple Work-Holding Devices

Many welding shops have a collection of such simple work-holding devices as Figs. 1, 2 and 3. Some of these jigs are adaptable to a great number of welding applications and are used almost daily. Others may be used only occasionally for specialized work. By and large, most of this equipment is used to hold the edges of sheets in alignment, to keep parts properly spaced during welding, to align bars, angles and other shapes for joining.

In welding butt joints in sheet metal, it is common practice to use two heavy bars (Fig. 4) to aid the operation. These are placed parallel to the seam, an inch or two back from the joint, after the sheet has been properly spaced. The weight of the bars tends to minimize bulges in the sheet and also to retard lateral movement. In this manner the bars regulate somewhat the speed at which the far ends are brought together by the heat of welding. By varying the weight of the bars and providing adjustable means for clamping them, this simple jig can be made to control accurately the movement of the sheet-metal members.

Bars, strips of heavy plate or other bulky sections of iron or steel placed along a seam will also serve to reduce buckling or distortion by conducting some of the heat out of the sheet. When the cost is justified, the bars can be hollow and water-cooled or copper insets can be used. Either method provides more efficient heat removal. For welding copper and other metals that are rapid heat conductors, asbestos or some other form of insulation is frequently required between the bars and sheet to prevent conduction of heat from the weld area.

Eccentric clamping arrangements (Fig. 5) are widely used for tightening purposes. There are two types: the eccentric shaft and the eccentric lever. Both of them make it extremely easy to insert, lock and remove the work from the jig. The eccentric shaft should be arranged so that half a turn causes the wider portion of the shaft to bear on a connecting rod and thus apply clamping pressure.

V-Blocks and C-Clamps

Bars, tubing, small-diameter pipe and parts of curved, angular or irregular cross-section can be conveniently lined up for welding by the use of V-blocks. Guides of this kind can be either cast or shaped from heavy steel sections with the oxyacetylene cutting torch. They should be accurately machined so that any work supported in them when they are on a level surface will be true after welding is completed.

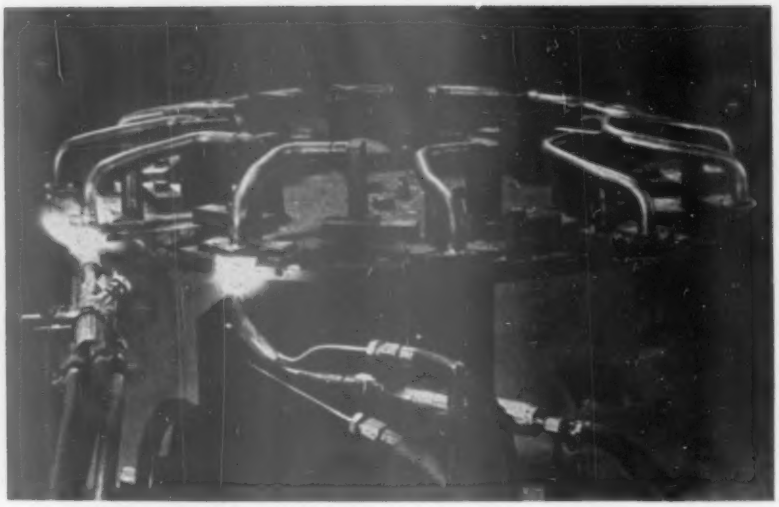
Proper alignment and very satisfactory results can also be obtained by using C-clamps to hold the work, which may be clamped to the surface of a welding table, to straight bars, to the flange of a section of rail, to lengths of angles, etc. For obvious reasons, C-clamps are restricted to the ends of a seam; nevertheless, they are useful in a great number of ways.

To make a corner weld in a rectangular container, for instance, C-clamps can be used to hold the two edges to a section of angle. By grinding off or grooving the corner of the angle clamped behind the weld (Fig. 6). a slight space is provided that makes it easier to obtain complete penetration.

H-Clamps and Wedged Clamps

Chief among other common clamps and spacing devices is the simple arrangement known as the H-clamp (Fig. 7). Basically, such a clamp consists of two pieces of plate, usually about 6 in. long and 2 in. wide, drilled or slotted in the center.

9—SEMIAUTOMATIC JIG for brazing. The operator turns the large turntable by hand to rotate the brazed assemblies



10—AUTOMATIC JIG for silver brazing flanges and suction tubes for automobile oil pumps. Self-indexing, motor-driven table delivers work to fixed torches. Holding fixtures prevent improper positioning

A 3/16-in. or 1/4-in. bolt with wing nut passes through the holes. The dimensions, of course, vary with the work.

Thickness of the work, location of the seams and clearance on either side of the weld will determine both the size of the clamping jaws and the length and diameter of the wing bolts needed. When H-clamps are to hold curved or irregular surfaces in alignment, the jaws can be bent to conform to the contour of the work. Clamps of this kind are particularly valuable for holding the edges of tank shells and other cylindrical products.

Because they can be placed at any point along a seam, in any desired number, H-clamps are especially useful wherever long joints in light-gauge sheet must be welded. They enable the work to be clamped at such close intervals that the possibility of serious deformation is practically eliminated. As welding progresses, the clamps can be removed one by one or can be moved along the joint ahead of the welding to assure correct spacing until the entire weld is completed.

The wedged H-clamp or double L-clamp (Fig. 8) is a variation of the simple H-clamp that is frequently used to hold sheets when it is difficult or impossible to reach the reverse side of the seam. A T-shaped section about 3 in. long, or a tee made by welding together two pieces of scrap metal, is slotted to receive a wedge-shaped key. Two washers or flat plates are cut from small pieces of scrap, slotted and placed over the slotted member of the tee. Sheet edges are then placed between the jaws formed by the washers, and these washers are clamped tightly to the sheet by driving the key into the slot. Such clamps are simple, inexpensive and easy to make with the cutting torch and welding rod from scrap material; they can be made up especially to meet the requirements of any particular job.

Wedged H-clamps or double L-clamps are used in the same ways as the H-clamps previously described. If too wide a gap is being left as welding progresses, the keys of clamps still in the joint can be loosened to allow more lateral movements in the sheet. In this way, the results of the expansion will be retarded rather than stopped altogether, and some lateral distortion will be avoided.

Wedges and Levers

Sometimes it is necessary to supplement clamps with wedges and levers in order to take care of local conditions during welding. If the space between the sheets seems to be closing too rapidly, wedges can be placed along the joint to supplement the clamps already placed, making it unnecessary to remove the clamps or realign the parts.

Perhaps the edges do not come together in the same plane. In such a case, levers can be used as pry bars to bring the lower edge up to the level of the other. A discarded automobile spring leaf is ideal for this purpose. It has sufficient stiffness, and the taper at the end is particularly handy in the narrow gap close to the weld. In some cases a helper may be needed to pry the sheet edges into alignment; in other cases the weight of the lever alone will correctly adjust the edges.

Special-Purpose Jigs

Between the simple shop accessories and the more complicated work-holding devices, there is no sharply defined line. Special-purpose jigs generally amount to no more than elaborate developments and combinations of the simple jigging devices already described. They can, however, be broadly classified as tack-welding jigs and jigs in which the work is held until finished.

Sometimes the assembly of a welded structure may be so complex that the jig required would not give the operator convenient access to all parts of the joints. When this is the case, a more simple jig can be used to hold the parts for tack welding only. Final welding can then be handled with a second jig, or welding of the tack-welded parts may be completed without a jig provided that proper allowances for distortion have been made beforehand.

Many repair jobs are done by the tack-welding method. The majority of jigs for production operations,

however, are designed primarily to eliminate tack welding and so reduce handling time. Interruptions caused by cutting out tacks and rewelding are thus avoided, and serious stress problems may sometimes be eliminated.

Four Basic Jig Types

Jigs in which the parts are assembled and held until welding is completed, may be classified as stationary, freely movable, semiautomatic and automatic.

When the jig design makes it necessary for the operator to move about the work, the jig is termed "stationary." This type of jig is commonly used in repair operations or in connection with large work. Clamping arrangements usually fasten the work to the jig or hold the work firmly in place by clamping members of the jig together.

Ability to move the jig at will is a great convenience to the welding operator. Jigs so arranged that the work can be locked tight and rotated during welding represent the movable or swinging type. Such a jig enables the operator to keep the assembly in a continuous downhand welding position. A common example is the supporting rollers used for the welding of circumferential seams in round tanks or containers. Jigs for holding metal door frames and sashes are frequently mounted centrally on a turntable to permit all corners to be worked on from a single welding position.

A semiautomatic jig (Fig. 9) is one equipped with an added mechanism that makes it possible for the operator to move the work without interrupting the welding. Ratchets, pulleys, cable and counterweight releases, brakes that regulate the movement of the jig, indexing devices and simple levers are all used to good advantage. Semiautomatic jigs are generally hand or foot operated by the weldor, but some of the more complicated ones require a helper.

Automatic jigs are particularly valuable for manufacturing relatively small parts in large quantities. They are usually motor-driven in order to keep the area to be welded constantly before the operator. When completely mechanized as in Fig. 10, one or more stationary torches are mounted to do the welding so that the operator has only to load and unload the jig. Speed of movement can be uniform, variable or intermittent, as arranged to suit the job at hand.

The motor-driven turntable of Fig. 10 was designed for silver brazing of flanges and suction tubes for automobile oil pumps. Holding fixtures on the turntable are so arranged that parts cannot be improperly positioned. Table indexes automatically to bring the assemblies over the torches.

Design Principles

Special-purpose jigs, whether for maintenance or production work, must cover a variety of needs and special conditions. To be efficient, they must also measure up to the requirements of simplicity, rigidity, rapid action, accuracy and accessibility.

Simplicity: Other things being equal, the simplest design is always the best. Jigs should operate smoothly and quickly to facilitate loading and unloading; in planning, remember that jigs are usually loaded cold and unloaded while both work and jig are hot. Normally, more of this heat and consequent expansion will be in the welded assembly. Unless proper allowance has been made, the work may bind.

Rigidity: The body of a jig must be stiff and rugged to withstand stresses that develop during operation and tend to spring both jig and work out of line. The jig must hold the work in correct alignment until welding is completed.

Rapid Action: All clamps should operate easily and rapidly. They should be positioned away from the welding arc or flame so that they will not overheat and should also be so located that they will afford clearance for easy loading and unloading. To avoid loss, clamps should be made integral parts of the jigs.

Accuracy: Care should be taken to place locating points so that the parts to be welded can be positioned accurately with minimum adjustment by the operator. Accuracy in the finished work depends upon these locating points, which usually consist of pads, bosses, lugs, pins, studs, V-blocks, stationary or movable screws, cup-and-cone arrangements, finished holes, corners and edges. Whatever the type of locating point, it may be cast solid with the jig body, be permanently fixed to it or be adjustable. Adjustable locating points are often desirable from the standpoint of flexibility; fixed locating points best satisfy the requirement of minimum adjustment by the operator. Whatever their nature, all locating points must be firm and rigid so that they will not be forced out of alignment as the work is clamped or when the work is heated during welding. Gauges, stops, pinions, mandrels and the body of the jig can usually be so arranged that the jig will not close if parts are placed in an incorrect position.

Accessibility: The jig itself should be so designed and all protruding parts so located that joints to be welded will be easily accessible. Any construction that tends to restrict electrode and torch manipulation or to force the operator to work in a cramped position must be avoided. Methods that give the required bulk in clamping jaws while allowing free access to joints are shown in Fig. 4. Clamping or locking arrangements that would ordinarily reach across the line of weld may be offset so that they will not interfere with the operator.

Materials for Jigs

The size and weight of the article to be welded determines what type of construction should be required for the body of the jig. Boxlike jigs, which wholly or partly enclose the work, are often made of iron or steel castings. Such construction offers a firm base for the clamps.

Jig bodies can also be fabricated from plates, bars, shapes, strips, rails, or combinations of these with iron or steel castings. Often it is both profitable and economical to use scrap materials.

Whether the jig is made of new or old metal, welding and cutting will prove invaluable in its fabrication by eliminating expensive special castings and machined parts. Because of its strength and weight-saving advantages, the welded joint is particularly suitable for the special design and construction that jigs normally require.

DETERMINED APPRENTICES are these 16 employees of Carnegie-Illinois Steel Corp., who recently received certificates of completion of their 3 to 4 year training course despite interruption of wartime service. Left to right they are: Herbert Sonntag, weldor; Edward Ihnat, bricklayer; Philip Vaclavik, weldor; John Rados, wireman; Jack Slatton, boilermaker; Steve Domanski, armature winder; John Kepchar, pattern maker; Lawrence Bodomer, bricklayer; Ralph Wells, machinist; Julius P. Chudziki, bricklayer; Frank Pishkur, weldor; Donald E. Smith, weldor; Leo Linoski, weldor; Alex Anderson, weldor; Floyd P. Jones, weldor; George Tarkane, Jr., weldor. Certificates were presented by S. M. Jenks (extreme right), general superintendent of the Gary works of Carnegie-Illinois

. . . a very good man named Frank

FRANK PISHKUR, weldor extraordinary at Carnegie-Illinois, can weld as well as any man with two arms

BUILDING UP a worn wobbler on a pinion used in the steel mill is one of many jobs which Frank can handle

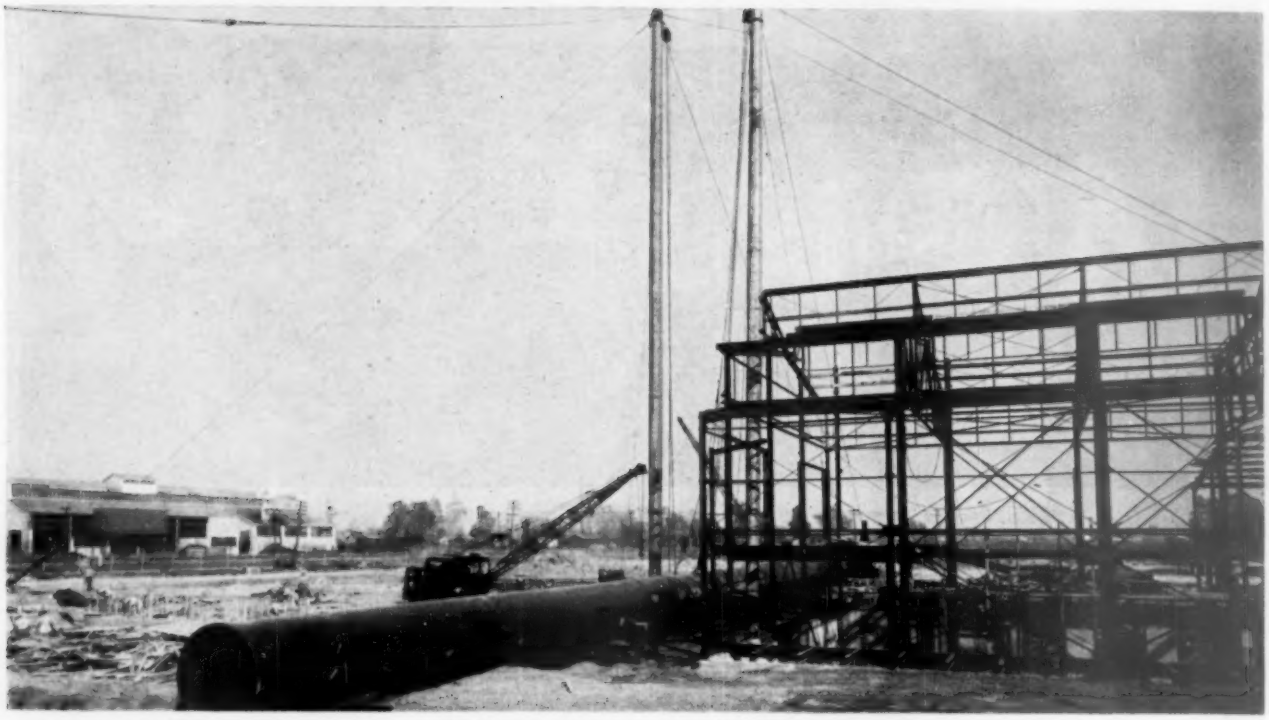
Four years ago Frank Pishkur was a staff sergeant in the First Infantry Division when it fought its way into Germany's stubborn Siegfried line. Frank and his platoon of men were attacking an enemy strong point. The counterfire was heavy. An artillery shell exploded, and Frank was hurled to the ground.

In the hospital, Frank's right arm had to be amputated at the shoulder. After the operation Frank had time for a lot of thinking . . . about his wife, his 2-year old son, his home and his future. Before Frank had entered the army in 1942, he had been training as a weldor in the Gary, Ind., works of the Carnegie-Illinois Steel Corp. Could he continue to be a good weldor with only his left arm?

If you could see Frank today at work in this same U. S. Steel subsidiary plant, you would know the answer to that question. For Frank is now a skilled weldor in spite of his handicap. It took plenty of courage, but Frank made the grade.

Just a short time ago a very good man named Frank was one of 16 apprentices at the Gary works of Carnegie-Illinois who received certificates of completion. This entire group started apprentice training before Uncle Sam beckoned, then went out to collect enough medals and battle stars to sink an ore boat. After the war they returned to Gary, one minus a right arm, to complete their 3 to 4 year training course.

United States Steel is proud to employ men like Frank.



1—STACK WAS DELIVERED in three prefabricated sections, which were field welded together on the ground before erection. Note the two 110-ft poles and truck-mounted crane that were needed to raise the 175-ft tube

Steel Stack

Among big jobs successfully completed by welding was the construction of a 175-ft steel stack for a 150-ton glass furnace

BY GORDON GALLOWAY, *Assistant District Manager, The Austin Co., Los Angeles*

PLANNED as a model factory, the new 27-acre plant of the Ball Brothers Glass Co., at El Monte, Calif., incorporates all of the best practices in operation, layout and manufacturing which have been developed in the glass container industry during the past 60 years. This latest Ball Brothers enterprise is ninth in a chain of glass, zinc, rubber and paper plants now extending from coast to coast. It was designed and constructed by The Austin Company, nationally operating firm of engineers and builders.

Furnace and Stack

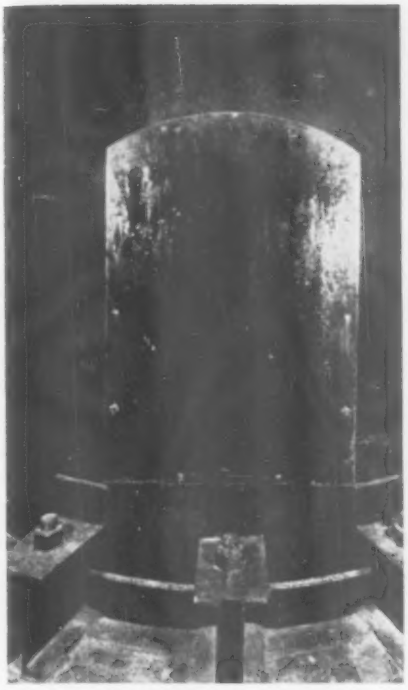
The firm's first glass-making furnace west of the Rocky Mountains has an initial daily production of 150 tons of glassware. The furnace features front feeding and side firing and is equipped with two regenerators. The two furnace flues join at the by-pass valve, from there going directly into the stack. The 175-ft all-welded steel stack, which originates at the basement level of the furnace room, has a 9 ft ID at the top of the base and is lined with brick for the first 60 ft. It tapers to an ID of 6 ft 6 in. at the 55-ft level.

In keeping with the modern design of the plant, the stack was designed for all-welded construction and was fabricated of ASTM A-7 structural quality steel. The fabrication was handled by the Southwest Manufacturing Co., Alhambra, Calif.

The stack was made in three sections and shipped knocked-down to the plant location, where field welds were made prior to erection. The base section was the frustum of a cone having a slope of approximately $2\frac{1}{64}$ in. to every 12 in. This 55-ft section consists of six courses of $\frac{7}{16}$-in. plate, each course 110 in. high. The outside seams, both girth and longitudinal, were welded by automatic submerged-melt welding. The inside seams were hand welded in a 60-deg bevel. This procedure was used for making all shop welds.

The center section was made of eight courses: six were 90 in. high and two were 80 in. Plate varied in thickness from $\frac{7}{16}$ in. in the two lower courses to $\frac{1}{4}$ in. in the two upper 80-in. courses. Of the four middle courses, the lower two were of $\frac{3}{8}$-in. plate and the upper two of $\frac{5}{16}$-in. plate. The section had a total length of 58 ft 4 in.

The top section was 61 ft 8 in. in length and consisted of eight courses of plate ranging in thickness from $\frac{1}{4}$ to $\frac{3}{16}$ in. In this section, the heavier plate was at top and bottom, the $\frac{3}{16}$-in. plate being allotted to the five middle courses.



2—CHANNELS and angle clips anchored the stack to its foundation

3—LADDER AND CAGE were bolted to welded clips after stack was in place. The cage consisted of a series of hoops welded to strings of angles

K for Glass Plant

(See front cover illustration)

After the prefabricated sections had been delivered to the site, they were aligned on special cribbing and field welded. Previously, for each line of junction, a 3/16 by 1 in. back-up bar had been shop welded onto one section in order to provide a male and female fitting to facilitate alignment.

The ends of the section formed at the junction of the stack's lower and mid sections were beveled to an included angle of 70 deg. The weld was made with a 1/8-in. gap at the root to insure a good tie-in between the stack sections and the back-up bar.

The girth joint between the mid and top sections of the stack was likewise made with the aid of a 3/16 by 1 in. back-up bar. For this weld, plate edges were not beveled and the ends of the two 1/4-in. plates were held approximately 1/4 in. apart. A two-pass field weld filled the gap. Again the stack sections were tied to the back-up bar.

After the field welds had been completed, the stack was ready to be erected (Fig. 1). Assembly work was done with the stack's center of gravity approximately on the foundation site. This greatly simplified the erection, which was accomplished by rigging from two 110-ft gin poles. Two hoists were used, one on each pole. The reeving was for a 13-part line. In addition, a small truck-mounted crane was employed to handle the base of the stack as it was moved along the ground to position.

When the stack had been mounted on its foundation, it was securely held in place by 16 anchor bolts fastened to channel and angle lugs welded to the base of the stack (Fig. 2). Anchor bolt holes were equally spaced 22½ deg apart on a circle of 10-ft diameter.

Welded Ladder and Cage

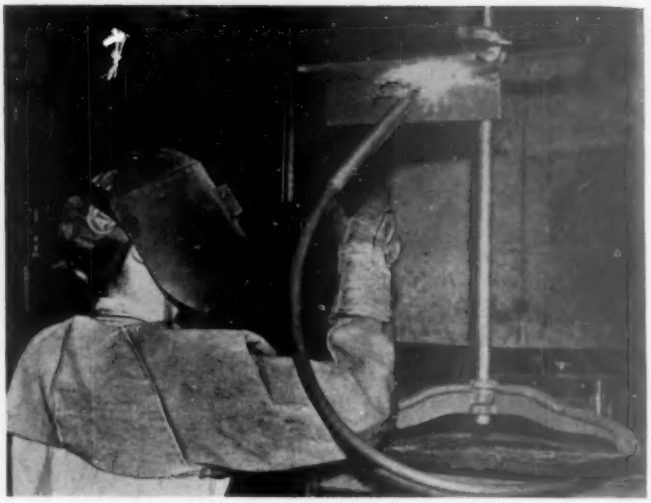
The next job in connection with the erection of the stack was to fasten in place the shop-fabricated ladder and cage. These were shipped knocked-down in five sections for erection in the field.

The ladder began at a point 14 ft above the base of the stack. Rungs were 3/4-in. round bars, 15 3/8 in. long, welded at both ends to 3/8 by 2 in. stringer bars. The stringers had 13/16-in. holes, spaced at 1-ft intervals, to accommodate the ladder rungs. Rungs were plug welded into place.

A protective cage (shown in Fig. 3) started 21 ft 6 in. above the base and continued to the top of the stack. The cage was held in place by 1/4 by 4 in. bars spaced at approximately 7-ft intervals. These bands were bent to form hoops surrounding the ladder and were welded to strings of 1¼ by 1¼ by 1/8 in. angles.

The cage was shop welded to the ladder except at the points where field splices were to be made. Cage and ladder were bolted to welded clips at intervals of from 10 to 12 ft, depending upon the section of the stack.

Inert Arc goes Metal Arc*



Development of a practical gun makes possible a new gas-shielded arc process with many possibilities for aluminum welding

BY JESSE S. SOHN, *Air Reduction Laboratories*

AND A. N. KUGLER, *Technical Sales Div., Air Reduction Sales Co.*

For many years it has been recognized that existing welding processes are not completely satisfactory for the joining of some metals. This deficiency is particularly apparent when welding relatively heavy sections in the vertical and overhead positions, and is accentuated when working with non-ferrous metals. In a new process, a consumable filler wire is continually deposited in a controlled gaseous atmosphere. This is known as the "Aircomatic" process and may also be designated as gas-shielded metal-arc welding.

Electrode in Wire Form

Briefly, this new process consists of feeding a bare or processed filler metal in wire form through a holder. The filler metal carries welding current, and an arc is maintained between the end of the wire and the work. Power may be supplied from a standard welding generator. The arc is maintained within a controlled envelope of shielding gas. The equipment developed for the process includes both a manual gun and an automatic head.

With the manual unit, welding may be performed in all positions; *i.e.*, flat, horizontal, vertical and overhead. All of the standard joint designs may be welded in these positions. Single or multilayer welds can be deposited, using either beading or weaving techniques. Vertical welds may be made with either upward or downward travel. As far as is now known, this is the first time that continuous wire feed has been employed for practical welding in the vertical and overhead positions.

Continuing research indicates that this process is capable of welding many metals. In particular it is adapted to the welding of aluminum and its alloys. Direct current, reversed polarity, provides the necessary arc conditions. Standard d-c welding generators, including constant-potential, multiple-operator units, are suitable. The welding grade argon currently supplied for inert-arc welding has been found to be a satisfactory shielding gas for welding aluminum by the new process.

High Current Densities

Current densities twelve times those used in ordinary metal-arc welding have been successfully employed. Such high current densities necessitate high rates of wire feed in order to make satisfactory welds. Wire speeds for the manual welding gun range from 100 to 300 ipm.

The arc may be described as non-sensitive since changes in arc length result in smaller changes in arc voltage than are encountered in normal metal-arc welding. The arc consists of a relatively narrow incandescent core surrounded by an umbrella-shaped envelope. The outer envelope provides a cleaning action, eliminating the need for welding fluxes.

For the manual welding of aluminum, only three sizes of wire are needed: $\frac{3}{64}$, $\frac{1}{16}$ and $\frac{3}{32}$ in. The overall current range is 70-450 amp, which permits welding of metal thicknesses from $\frac{1}{8}$ up to 2 in. and more.

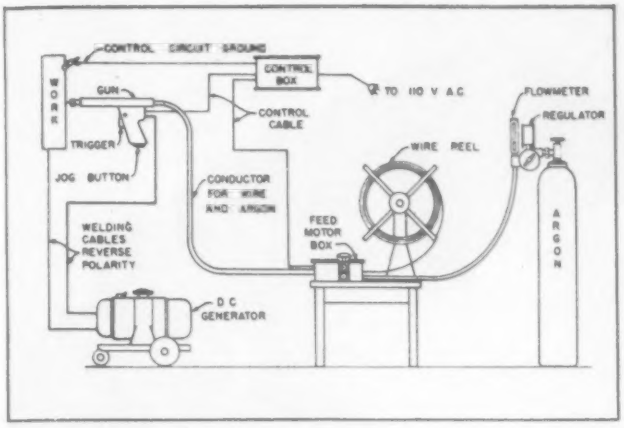
The selection of filler metal composition is governed by the metal to be welded. For the welding of 2S and 3S material, 2S wire is recommended; for 52S and 61S material, either the 43S or 716 analyses may be used. The process affords promise of reducing some of the limitations now encountered in the welding of heat-treatable aluminum alloys.

Aluminum Welding Speeds

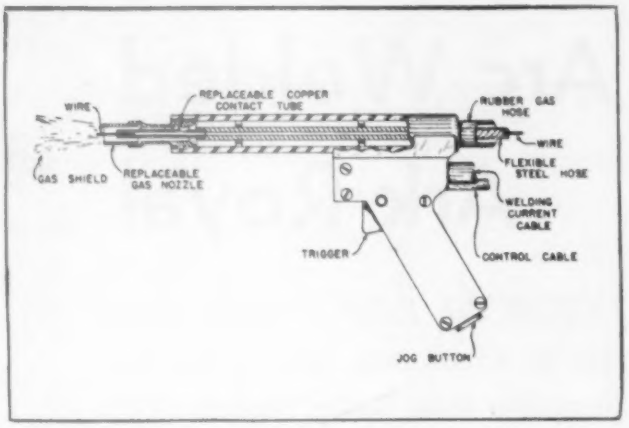
	Time, minutes	Length of Bead, in.	Speed, ipm
Gas	1:12	5½	4.6
Arc	0:32	5¼	9.8
Inert-Gas-Shielded, Tungsten Electrode	1:09	6	5.2
Inert-Gas-Shielded, Consumable Electrode*	0:20	12	36.0

*170 amp; ¼-in. plate; wire feed of 165 ipm

*Abstract of a paper presented before the 29th annual meeting of the American Welding Society, Philadelphia, Oct. 24-29, 1948.



1—**HOW EQUIPMENT** is connected. Both the argon and the electrode wire must pass through feed motor box



2—**WELDING GUN** details. Trigger may be locked in "on" position. Jog button permits feed without welding

Component parts are illustrated schematically in Fig. 1. The welding gun has: (1) an attached welding cable from the generator; (2) a gas (argon) hose, concentric with the metallic tube for conveying the filler wire; and (3) a small three-conductor control cable. At their other ends, the gas hose and wire conductor are connected to the feed motor box. The control cable also connects with the feed motor box, which contains the governor-controlled motor, speed reducer, feed rolls and a solenoid valve. The control box contains the relays which control operation of the wire feed.

Manual Welding Gun

The gun is pictured diagrammatically in Fig. 2. The trigger readies the unit for welding, and the "jog button" feeds wire when not welding. When the trigger is depressed (it may be locked in the "on" position by means of a button), it starts the argon flow. The electrode, which should project ½ to ¾ in. from the gas nozzle, is then scratched on the work. As soon as arc voltage is established, the controls operate to energize the feed motor and deliver filler metal.

A study of Fig. 1 will show the general paths of the argon shielding gas and welding current. The argon passes down the "barrel" of the gun and issues from the gas nozzle around the wire electrode. Since both the gas nozzle and the wire guide tube are close to the welding arc, they will gradually deteriorate and are therefore of simple construction to permit rapid and economical replacement.

The wire and the argon are carried in one conductor. The feed motor box contains the governor-controlled driving motor, which provides the variable speeds necessary for the filler metal feed. Operating on a 110-volt circuit, this motor drives a pair of feed rolls through a speed reducer. The rolls draw the filler metal wire from the reel and propel it to the gun. A solenoid valve turns on and shuts off the flow of argon as controlled by the trigger on the gun. When once established, this speed remains constant regardless of what takes place at the welding arc. Selection of a welding current and a wire feed speed for a given size of filler wire results in a definite arc length and hence arc voltage. The inherent self-regulation of the arc resulting from the specific combination of a drooping generator characteristic and high burn-off rate makes this welding process essentially automatic.

The arc is initiated by scratching the electrode rather than tapping. The gun is moved so as to have the shield about ½ in. from the work and held so that it points ahead in the direction of welding; *i.e.*, forehand welding as defined for the oxyacetylene process. To terminate a weld, the arc is broken with a quick snap. If a contactor is used in the circuit, releasing the trigger on the gun cuts welding power, wire feed and argon flow. The length of the arc should be $\frac{1}{16}$ to $\frac{3}{16}$ in. In addition, holding the gas nozzle much over ½ in. from the work will reduce the effectiveness of the gas shield.

For welding aluminum, the flow of argon is not critical as long as it is maintained within reasonable limits. When welding with the manual gun, argon flows between 20 and 50 cfh are used. Once the flow has been determined for a given welding condition, it may be varied by as much as plus or minus 10% without adversely affecting the welding operation. It has been demonstrated experimentally that up to 20% more argon will be needed when welding fillet welds on tee joint in order to provide shielding gas at the root of the joint.

Weld Properties

Mechanical properties of aluminum welds are equal to the properties obtained in castings of the same analysis as the filler metal. It may be stated generally that the welds will be superior to welds made with aluminum metal-arc electrodes. Under proper conditions, the quality will approach that obtainable with the inert-gas tungsten arc method.

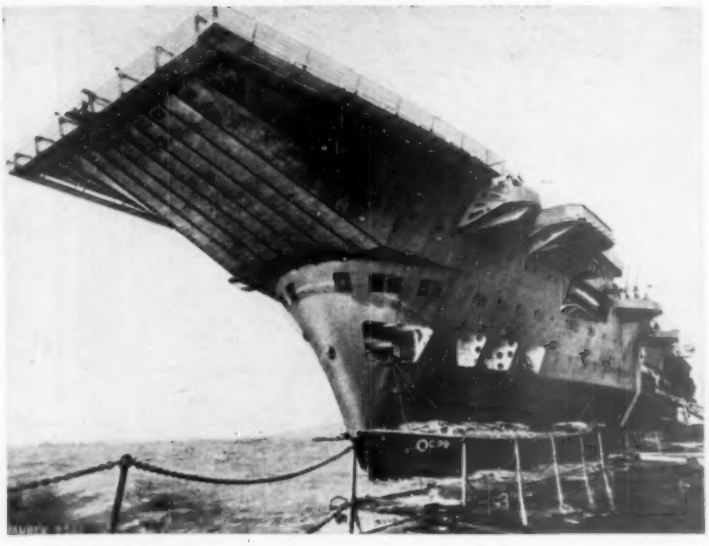
The welds are of excellent surface appearance. Porosity may be encountered, including microporosity that is not detectable using normal radiographic procedures. Tensile strengths of 27,000 psi with 8 to 10% elongation have been obtained on 43S all-weld-metal specimens welded in the vertical position. It is recommended that both base metal and filler wire be cleaned to insure the production of high quality welds.

Welding of heavy aluminum sections may be accomplished with little or no preheat. This practice is in sharp contrast to other processes.

Arc Welded Ark Royal

Original *Ark Royal,* a famed British aircraft carrier, was sunk by the Germans after many battles. She was a 65% welded structure. Her successor, who retains the proud old name, is an 80% welded ship of greater draft and beam

BY E. D' ACRE LACY



OLD ARK ROYAL earned her place as one of the great historical warships. She was sunk many times in the imagination of Nazi Propaganda Minister Goebbels before being sunk in fact

THE British aircraft carrier H. M. S. *Ark Royal,* which did such valiant service before she was finally sunk by the Germans, will always remain one of the famous historical warships of all times. Now that a new ship of the same name has been completed, it is thought that some comparison in the welding between the two aircraft carriers will be of interest to shipbuilders and welding engineers.

The old *Ark Royal* was just over 800 ft in overall length; the new vessel is about the same length but has considerably more beam, greater depth and draft and, consequently, much increased displacement and power. Both the old and the new vessels were designed by the Admiralty naval constructors, and the contracts were entrusted to Messrs. Cammell Laird & Co., Ltd., Birkenhead.

The old vessel was built of Admiralty mild and D quality steels, and about 65% of the structure was welded. The principal strength members of the hull were riveted and included:

(1) The outer bottom plating and frames abaft bulkhead 23 up to the lower hangar deck, and the flight deck sheer strakes and strake below, amidships.

(2) The inner bottom plating and frames, vertical keel except at the extreme ends, engine and boiler seatings and shaft stools.

(3) The flight-deck plating, beams and girders within the limits of the upper hangar and the deep beams under the upper hangar deck, two top strakes of the hangar bulkheads and all I-beam stiffeners in way of deep beams.

(4) The protective bulkheads; the main transverse bulkhead frame beams up to the main deck and behind armor and heavy deck beams under armor joints.

(5) Shaft-bracket stiffenings, gun supports, structural castings and forgings.

The area of plating completely welded in the old *Ark Royal* exceeded 300,000 sq ft and over 7,000 tons weight; the welding required about 9,000,000 feet of electrodes.

The New Vessel

The structural parts in the new ship are being built of Admiralty mild steel, DW, DI, and DKM quality steels, and N. C. armor plate. DW steel was introduced by the Admiralty in 1942, due to the extension of welding generally in the construction of H. M. ships. The essential property of this quality of steel is its capability of being arc welded on all thicknesses under normal shipyard practice. The steel has welding qualities closely in accordance with those of mild steel, more particularly for thicknesses below 20 psf (½ in.).

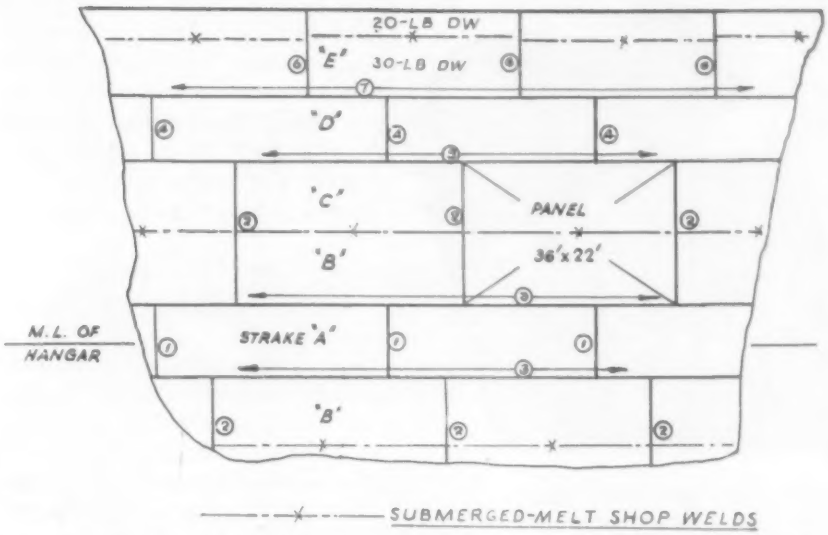
For 20 psf and above, an improved welding technique is recommended, including the use of larger gauge electrodes and shorter deposits than are normally used on mild steel of corresponding thicknesses. Welding DW steel at an equable temperature is preferable, and it is advisable to preheat thick plates in heavy structures where contraction restraint is unavoidable. The hardening qualities are such that hot cracking is likely to occur in initial deposits and cold cracking in the fusion zone between the weld and parent metals if the material is allowed to cool suddenly from the high welding temperatures.

DI steel is a low-alloy, high-tensile steel of good ductility, especially designed to protect the underwater parts of warships. DKM is a high-alloy, high-tensile steel which can be used as a structural steel where personnel and instruments have to be protected from bullets and splinters. It is a relatively ductile material and can be riveted or welded.

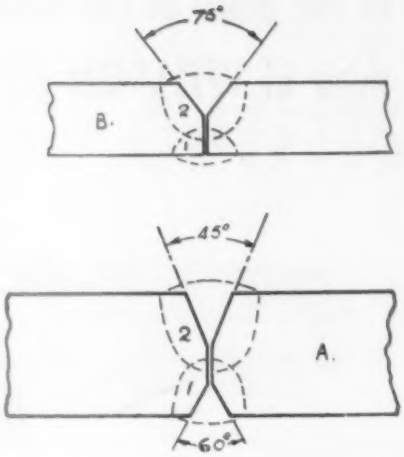
The new vessel is therefore a special steel structure in which various qualities of steel, having diverse welding characteristics, are efficiently connected to one another to produce a floating girder that is effective to absorb the stresses and strains of the continually changing loads which a ship has to withstand in service.

An 80% Welded Ship

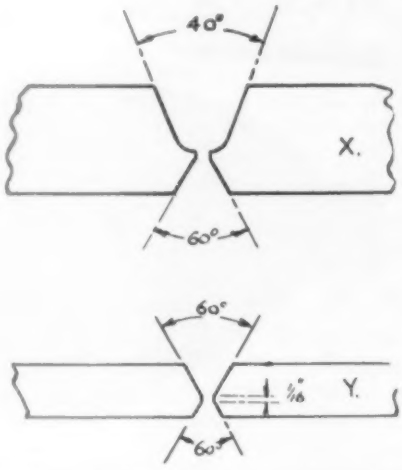
The welded area of the outer and inner bottom, decks and flats, main



1—WELDING SEQUENCE for flight deck plating is given in sketch above. The flight deck is more than a platform—it is an enormous shallow girder in which plating, beams and girders were knitted together by welding



2—SUBMERGED-MELT edge preparation for vee and double-vee butt joints was done in the shop



3—PLATES HAND WELDED at the ship were prepared as sketched

transverse and longitudinal bulkheads exceeds 600,000 sq ft, requiring over 15,000,000 running feet of electrodes. The comparable proportion of welded structure, quoted as about 65% in the old *Ark Royal,* is assessed at over 80% in the new one. The former had no structural armor nor DKM plating, but the underwater protection bulkheads were similarly riveted in both cases.

Considerable progress has been made in welding technique and erection procedure of making welded joints in the period between the two keel layings. The old *Ark* was constructed generally with relatively thin plating having joggled overlapped seams and flush butts with backstraps. The welding of overlapped joints is a legacy of riveting technique, which for plating of 17 psf (7/16 in.) and over has distinct disadvantages on account of welding, weight and strength.

The policy adopted in the new vessel was to butt weld as many veed joints as possible.

Progress in the welding of thick plating in the new ship has been expedited by the introduction of deep-penetration electrodes and automatic welding. All these processes were developed and applied since the keel of the new *Ark Royal* was laid by H. R. H. the Duchess of Kent five years ago.

The new methods were applied for prefabrication welding in the shop. Deep-penetration electrodes have been in general practice limited to the welding on panels of deck and bulkhead plating of 15 psf (3/8 in.).

Weight Saved, Strength Gained

An exceptional amount of heavy welding has been carried out in the the new ship. Parts were designed and constructed with the aims of eliminating every possible hole and rivet and of making every welded joint as near to the strength of the parent material as practicable. In addition, weight was saved and strength gained by adoption of welding in the connection of vital parts of the structure.

The flight deck, an important unit in the longitudinal and transverse strength of an aircraft carrier, forms the top member of the floating girder. It is subject to flexure in concurrently passing from the troughs to the crests of ocean waves and also has to withstand the constant shocks and vibrations from periodical operations of aircraft landing upon, running along and flying off the deck. In consequence, effective supports have to be embodied for arresting gear aft, safety barriers abreast the island and catapult tracks forward.

The flight deck of the new carrier (see side view in Fig. 1) is more than a deck in the sense of being simply a platform—it is an enormous shallow girder in itself. The plating, beams and girders are knitted together, principally by welding, into a closely stiffened network of steel. The portion over the upper hangar has to be able to support a heavy weight of structure. The seams are all butt welded. The plating is supported on transverse twin beams and intercostal I-beam girders run fore and aft. The beams and girders are riveted to deck plating.

There are seven strakes of plating over the upper hangar. The plates of "B" and "A" strakes, each side of the mid-hangar strake, are submerged-melt welded together in the shops into panels 36 by 22 ft and then drilled for the beams and girders. Edge preparation for submerged-melt shop welds is depicted in Fig. 2 and preparation for manual welding at the ship in Fig. 3. Outside

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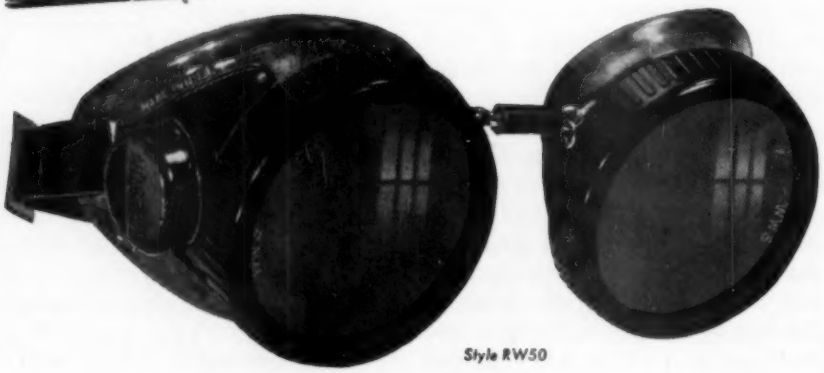

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the hangar limits, the 20-psf and 30-psf (¾ in.) DW plates are similarly welded. The beams and girders are generally tee bars, and these are welded downhand to the underside of the submerged-melt-welded panels. The panels generally do not exceed 10 tons of prefabricated steel.

Shrinkage Precautions

An important aspect of the erection of the new *Ark Royal* was the precautions taken during erection to guard against shrinkage, distortion and cracking. Detailed methods of procedure for welding and erection, which would insure sound construction and reduce locked-up stresses to a minimum, were worked out. An example is the sequence of flight deck welding shown in Fig. 1.

The features common to both vessels are to be found largely in the normal welding procedure to counteract shrinkage and distortion on the preconstruction of panels of the lighter parts of bulkheads, deck and shell on the skids, and the continued use of the step-back method of weld deposition.

When the welding was carried out in the skids and freedom of movement was possible in all directions, shrinkage was simply a question of making the usual allowances for frame and stiffener connections and butted joints on the frame spacing and overall dimensions and then giving careful attention to the order of the electrode depositions.

The meticulous care taken in erecting the keel was repeated in every part of the subsequent welding assemblies. In the double bottom, longitudinals had to be cut, veed and welded direct to the bulkhead floors on one side and to the table of the bulkhead stiffener on the other side in correct alignment so as to insure that the material fully developed the continuity of longitudinal strength of these members throughout the vessel. The floors also had to line up correctly for the attachment to the riveted lugs on the protective bulkhead of special steel stiffeners at each frame space. The complete assembly of the double-bottom reconstruction and the correct adjustments for welded construction were decisive in maintaining the designed dimensions.

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Includes AV-10 Gooseneck Welding torch supplied with four tips as selected from Nos. 1 to 6, Model RO-88 Oxygen Regulator, Model RA-88 Acetylene Regulator, One pair WM-25 Safety Spark Lighter, One RF-77 Combination Wrench, One pair WM-6 Goggles and Two 12½-foot lengths of ⅜ hose.

Complete Outfit $59.00
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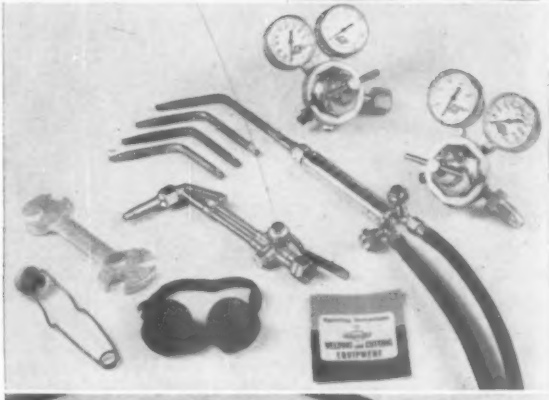

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Model HC-31 lever-controlled cutting torch with one tip. Complete outfit includes: Model RO-22 Oxygen Regulator, Model RA-22 Acetylene Regulator, Two 25-foot lengths of ¼" hose, One pair WM-6 Goggles, One WM-25 Safety Spark Lighter and One Combination Wrench.

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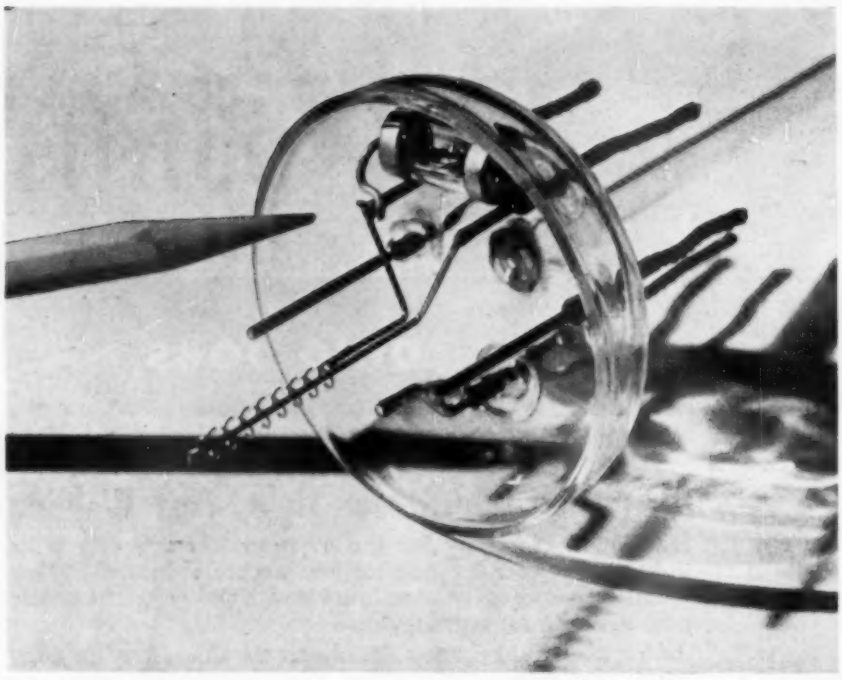

1—PENCIL SHOWS where two pieces of tungsten wire are joined to make the Z-shaped leads to the helical tungsten filament. "K Monel" wets tungsten

2—COMPLETED TUBE, type 5D22, is a beam tetrode power tube for F-M

Tungsten Arc Welded

One of the world's hardest jobs is to devise a set-up for arc welding tungsten wires. It can be done, however, and to precision standards

BY CLYDE B. CLASON

PURE tungsten has a melting point of 6,170 F—highest melting point of all metals. It retains its rigidity at high temperatures and when drawn into wires has a tensile strength approximating 500,000 psi. Add to these desirable qualities, a relatively high electrical resistance and high thermionic emission, and it is easy to see why tungsten has become so popular with makers of incandescent lamps and electronic tubes.

IT'S HARD TO HANDLE

Unfortunately, tungsten is about as difficult to work with as—well, tungsten. Only by a very special technique can it be prepared in a form that has any appreciable ductility. It oxidizes rapidly above red heat and becomes embrittled and corroded. Unless it is carefully protected from the air, no advantage can be taken of tungsten's high fusion temperatures.

Because of its extremely high melting point, tungsten makes excellent electrodes for those welding processes in which the arc is shielded from the atmosphere by hydrogen, argon or helium. This same high melting point, however, renders tungsten the most difficult of all metals to weld. The temperature of the metal arc, ranging around 6,000 F, is less than the melting point of tungsten. Flame temperatures are even lower. Obviously, tungsten cannot be welded by the inert-arc or atomic-hydrogen processes, in which it is used as the electrode or electrodes. There remains only the carbon arc, which has a temperature range of from 6,850 to 9,550 F.

It should be mentioned that tungsten wire can be resistance welded but only at high voltages, requiring special and expensive equipment.

TUBE MAKER'S PROBLEM

In developing a new type of "beam tetrode" power tube to be used in F-M and similar high-frequency transmission, engineers of the United Electronics Co., Newark, ran squarely against the problem of welding tungsten. It arose in the following manner:

Design of the new 5D22 tube called for two tungsten filament leads to be offset from center supports. Both the filament leads and the filament supports had to be accurately aligned with respect to other leads in the molded glass header. Now it is not difficult to bend a piece of wire into a Z-shape. But to bend tungsten wire so that the arms are exactly parallel and at a precise

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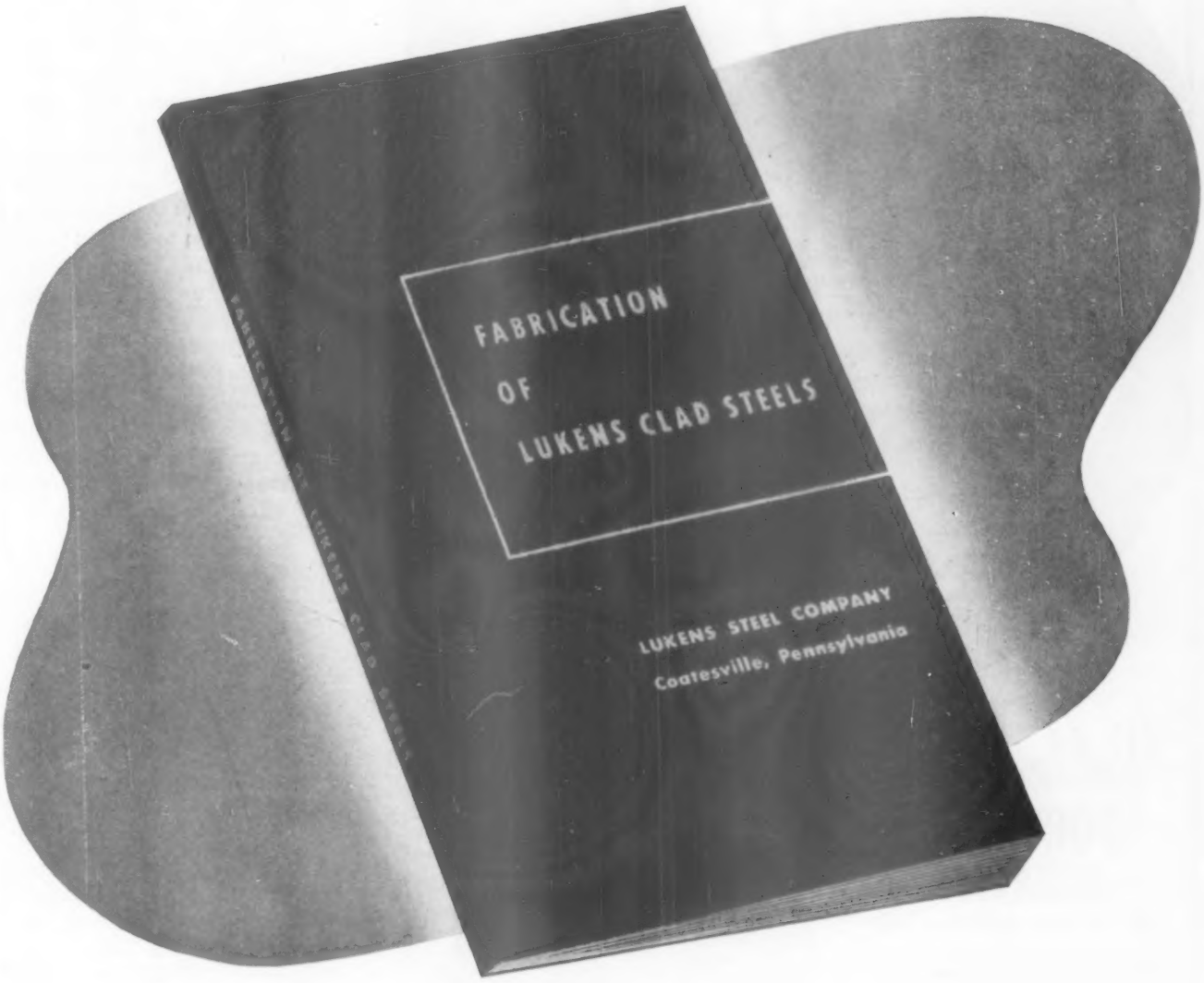

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specified distance from each other is an entirely different story.

Engineers of United Electronics decided that such a bending feat was beyond human powers and it would be necessary to make each lead from two pieces of wire. These could be welded together in a fixture especially designed to give exactly the right tolerances and dimensions—always provided that tungsten wire *could* be welded.

As hinted above, the carbon-arc method offered the greatest possibilities of success. It was deemed inexpedient, however, to attempt fusion welding because of the susceptibility of tungsten to oxidation and embrittlement at elevated temperatures. What was wanted was a brazing process, using a joining metal or alloy that would "wet" the tungsten and permit the wires to be joined at lower temperature than the melting point of tungsten. The question was: could a suitable metal be found?

Wetting the Tungsten

Experimenting was the only way to find out. When one alloy was tried, it failed to wet the tungsten properly. Another seemed to work all right, but when the joints were tested they snapped next to the welds, indicating that the tungsten had been embrittled. Finally, a satisfactory alloy was found in "K Monel," a high-strength nonmagnetic form of Monel that is hardenable by cold working and heat treatment. Like Monel, this nickel-copper alloy is a product of The International Nickel Co., Inc. It flows freely and wets the tungsten well, making a strong, smooth joint that is capable of resisting oxidation and corrosion at the elevated processing temperatures.

Fig. 1 shows how the two pieces of tungsten wire, are welded together to make the Z-shaped leads to the helical tungsten filament. A tiny eyelet of K Monel is placed around the end of one wire, and both pieces are mounted in a fixture. The fixture is raised into a hydrogen-filled glass bell, where the wires are joined with a carbon arc.

The completed power tube (Fig. 2) has a 250-watt anode dissipation and operates at full rated input at frequencies up to 75 megacycles.

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JET ENGINE, auto body, oil drilling equipment, farm tractors were displayed to represent some of the uses of alloy steel

30th Annual Metal Show

BY W. C. HENZLIK

LARGEST crowd ever to attend a National Metal Exposition jammed Philadelphia's Commercial Museum and Convention Halls the week of October 25 to 29. More than 45,000 people from every state, Europe and South America thronged to see the colorful show, 30th of its kind to be sponsored by the American Society for Metals.

Two spacious floors of the Convention Hall and the big Convention Annex were crowded with every type of metal-working machinery from 10-ton presses down to small tools weighing a few ounces. Welding equipment and supplies dominated the Metal Show as in previous years, taking up approximately 20% of the exhibit space. Flame-cutting, metallizing and positioning equipment were also prominently displayed.

"Salute to Alloy Steels," the theme of the show, was depicted on the stage of Convention Hall. Six large booths represented the main divisions of industry using alloy steels. Aircraft, oil drilling, automotive, railroad, national defense and farm equipment components were shown as they have developed with improvements in alloy steel. Latest model aircraft reciprocating and jet engines were exhibited in cutaway section on the stage.

An entire corner of the floor of the Convention Annex was taken up by gas-operated flame-hardening, annealing and furnacing facilities.

With the exception of foundry operations and heavy forging, virtually every metal-working process was on exhibition in one of the three display areas. Tubes were drawn, small pipes were welded, parts were forged, machined, flame-hardened, annealed, etc.

Manual and automatic welding and hard-facing operations were on view in several booths on every floor. An unusual chance for comparison of the various equipment was offered.

U. S. Army Ordnance Department had several displays of arms making machines and showed movies of firing tests of new weapons.

U. S. Naval Experiment Station, Annapolis, Md., again had an elaborate display of welding equipment and test apparatus. Welding question-and-answer boards set up with "Yes" and "No" buttons were popular with the crowd. A loud buzz greeted wrong answers. Some of the questions were:

1. For any type of electrode the arc voltage is the same, regardless whether the power source is a c-p or v-p generator.

2. Open-circuit voltage of 80 to 100 volts a-c or d-c is sufficient to kill a person when he is grounded.

3. In low-alloy steels, the chemical composition of weld metal must match that of the base metal.

Answers are, respectively: Yes, Yes and No.

Visitors to the Navy booth were invited to use a semiautomatic welding head originally constructed to test electrodes. Underwater welding and cutting was demonstrated to spectators in a large tank of water with glass sides. Long waterproof gloves allowed manipulation of the torches under the surface.

Metallographic exhibits were shown in an areaway connecting the main hall and annex. Microstructures of various irons and steels, non-ferrous alloys, powder metals, weld structures and surface phenomena were illustrated in colors, and black and white. Test results of metal specimens by non-optical and other means were also displayed.

Visitors to the show were given chances at various booths to win such items as crates of California oranges, "beryllium" fishing rods, a small arc welder, government bonds, and packages of electrodes. At many booths interested spectators were allowed to operate welding equipment and simple machine tools.

Inert-Arc Welding

(Using A-C High-Frequency Equipment

THICKNESS INCHES	TYPE OF WELD	WELDING CURRENT AMPERES			WELDING SPEED ipm	WELDING ROD		ARGON FLOW		REMARKS
		Flat	Vertical	Overhead		Size in.	Feet Rate ipm	lpm	cfh	
ALUMINUM Mechanical Welding, Grooved Steel Backup, A.C.H.F.										
0.025	30° Flange	45	—	—	28	None	None	5	11	
0.050	30° Flange	135	—	—	24	None	None	7	15	
0.064	30° Flange	130	—	—	48	None	None	8	17	
0.090	Butt	190	—	—	18	None	None	8	17	
0.125	Butt	315	—	—	48	None	None	8	17	
ALUMINUM Hand Welding, A.C.H.F.										
1/16	Butt	69	75 down	75	—	1/16	—	7	15	
1/16	Edge	63	58	58	—	None	None	7	15	
1/16	Corner	71	69 up	69	—	None	None	7	15	
1/16	Lap	81	58	69	—	None	None	7	15	
1/16	Fillet	69	92 down	75	—	1/16	—	7	15	
1/8	Butt	144	132 down	138	—	1/8	—	8	17	3/32" rod on overhead
1/8	Fillet	161	135 down	161	—	1/16	—	8	17	
1/4	Butt	288	259	247	—	1/8	—	12	25	
1/4	Fillet	316	247 up	—	—	3/16	—	12	25	1/8" rod on vertical
1/2	Butt	432	288	250	—	3/16	—	15	32	
1/2	Pos. Fillet	460	316	—	—	1/4	—	15	32	2 passes
3/4	Butt	500	—	—	—	1/4	—	15	32	5 passes—Back-chip with "bull-nose" chisel
1¼	Butt	500	—	—	—	1/4	—	15	32	8 passes—Back-chip with "bull-nose" chisel
STAINLESS STEEL Mechanical Welding, A.C.H.F.										
0.026	Butt	80	—	—	30	None	None	5	11	
0.050	Butt	140	—	—	22	None	None	5	11	
0.064	Butt	150	—	—	20	None	None	5	11	
STAINLESS STEEL Hand Welding, A.C.H.F.										
0.050	Butt	100	90 up	90	—	1/16	—	5	11	
0.050	Fillet	100	—	90	—	1/16	—	5	11	
1/8	Butt	150	140 up	135	—	3/32	—	5	11	1/16" rod on overhead and flat
1/8	Fillet	160	125 up	150	—	1/8	—	5	11	
MAGNESIUM (M1 ALLOY) Mechanical Welding, A.C.H.F., With Backup										
0.064	Butt	75	—	—	18	3/32	20	6	13	
0.128	Butt	150	—	—	14	1/8	17	9	19	
0.188	Butt	250	—	—	12	1/8	24	9	19	
1/4	Butt	350	—	—	10	1/8	28	9	19	
3/8	Butt	450	—	—	8	5/32	28	9	19	
1/2	Butt	550	—	—	6	5/32	24	11	24	
MAGNESIUM (M1 ALLOY) Hand Welding, A.C.H.F.										
0.040	Butt	45	—	—	—	3/32	1/8	6	13	Backup
0.064	Butt	60	—	—	—	3/32	1/8	6	13	Backup
0.064	Butt, Corner & Edge	35	—	—	—	3/32	1/8	6	13	No Backing
0.064	Fillet	60	—	—	—	3/32	1/8	6	13	
0.081	Butt	80	—	—	—	1/8	—	6	13	Backup
0.102	Butt	100	—	—	—	1/8	—	9	19	Backup
0.128	Butt	115	—	—	—	1/8	5/32	9	19	Backup
1/4	Butt	85	—	—	—	5/32	—	9	19	2 passes
3/8	Butt	100	—	—	—	5/32	3/16	9	19	2 passes
1/2	Butt	260	—	—	—	3/16	—	11	24	2 passes
3/4	Butt	370	—	—	—	3/16	1/4	17	36	2 passes

Data courtesy of Miller Electric Co. and The Linde Air Products Co.

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AUTOMATIC WELDING

FOR BUILDING UP HARD SURFACING

with all standard makes of Automatic Arc-Welding heads

Perfect Metal! Weld Smooth as Silk! Fast! No melt to put down or recover!

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Our field covers the jobs that other automatic-welding methods cannot handle.

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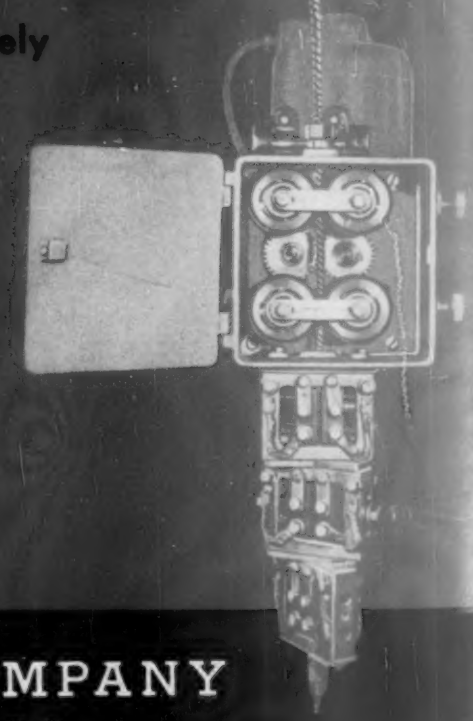

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"Give us the tools . . ."

For High Wages, Full Employment . . . Business Must Have Better Tools *and More Money to Pay for Them*

So far we have escaped the post-war depression predicted by leading government economists. How can we continue to frustrate gloomy prophets who see only depression ahead?

At the end of World War II the federal Director of Reconversion saw depression immediately ahead. He said we would have 6,000,000 unemployed four months after VJ-Day and 8,000,000 a few months later.

But we did not have depression. We did not because:

First, the American business man, sensing the obligations of a vastly more important post-war America, went ahead to build his plant and equipment to meet expanding domestic and world markets—markets bigger actually and potentially, in terms of world-wide trade and profits than any previously envisaged.

Second, the American businessman was able to get the money to go ahead. Since 1945 he has spent $50 billion building new plants and buying new equipment.

There may be other reasons why we missed a depression in 1946. But—make no mistake about it—what has powered our present prosperity is the $50 billion spent by businessmen since VJ-Day to improve their plants.

It provided jobs directly for 5 million people. It paid for more than half of our record-breaking steel output. It put in place the foundations of great new industries such as television. It strengthened the foundations of the chemical, machinery, plastics, steel and oil industries. It has expanded and improved our power systems throughout the country.

This spending has made the difference between prosperity and slump, between industrial strength and serious deterioration.

In fact, we know now that what business spends for new plants and new tools always makes the difference between prosperity and slump, the difference between national strength and weakness.

The accompanying chart tells the story. When we have spent heavily for new plants and equipment, we have had prosperity and strength. When we have not, we have been in trouble.

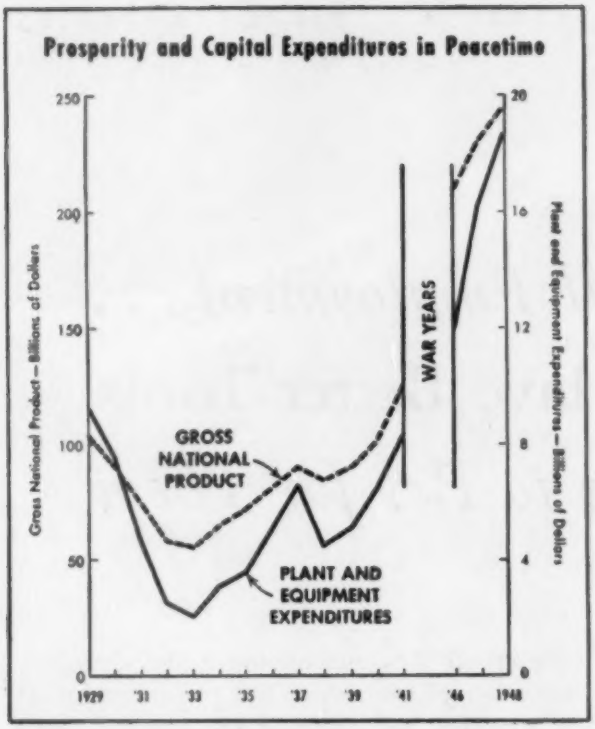
We would have been in trouble since VJ-Day except that business used its war reserves, plus two-thirds of its profits, plus borrowed money to improve and expand its facilities. This year industry is spending $19 billion this way.

Has this great post-war expansion actually made our economy a "mature economy"? Have we come now to the saturation point the New Dealers mistakenly said we had reached in the '30's?

The answer is no!

Proof of that answer is being developed through a McGraw-Hill national survey of "Business' Needs for New Plants and Equip-

continued on next page



ment" details of which will be given in this editorial series in coming months.

We have a bigger nation, more people, to serve right here at home. Further we must meet human needs which the war created around the world. Also, we must sustain a world position such as this country never assumed before.

Here are immediate things crying to be done.

1. Business still needs billions to expand production because our country and our needs are growing rapidly. Example: To meet the demand for power, electric utility companies must nearly double their present generating capacity in 10 years. That will cost more than $7.5 billion. To fill increasing needs for oil and gasoline, oil companies must spend at least as much.

2. Business still needs billions to get its plants up to date and overcome wear and tear. Examples: Over half a million of our freight cars, a third of the total, are more than a quarter of a century old. About two-thirds of the looms in the textile industry are more than 20 years old. Half of our coke ovens, basic equipment for iron and steel production, are more than 20 years old, and only half as efficient as modern ovens.

3. Business still needs many billions to do new things in dramatic new ways. Example: Machinery that will cut out 80% of the dirty, dangerous work of mining soft coal has been perfected. A new automobile engine plant will reduce the work that goes into engine-building by three-quarters.

Hundreds of similar things that our scientists and engineers have developed could be cited. They can be found in every industry. They hold immeasurable promise of adding to the abundance of American living. In fact, there is hardly a step along the whole route of industry—from roughing out raw materials to delivering finished goods—where there are not new and better ways of doing things standing ready for general use.

But the crucial question now is: Where is the money coming from to put to work these new and better ways of doing things?

Business has used its own resources so far... profits and reserves. The stock market, where industry traditionally has raised money from people willing to risk their savings, has been limping along, giving business no chance to get enough money on satisfactory terms. *Business now must look primarily to its own earnings for the money to carry out the improvements which are necessary if America is to keep itself strong and efficient.* The next editorial in this series will deal with this new and crucially-important role of profits.

But business can not count on profits alone to do the job. Profits are too uncertain.

From now on finding the money... to put new ideas and new equipment to work... to go ahead with the expansion and improvement that will thwart depression and build industrial strength *. . . calls for the support of all Americans everywhere.*

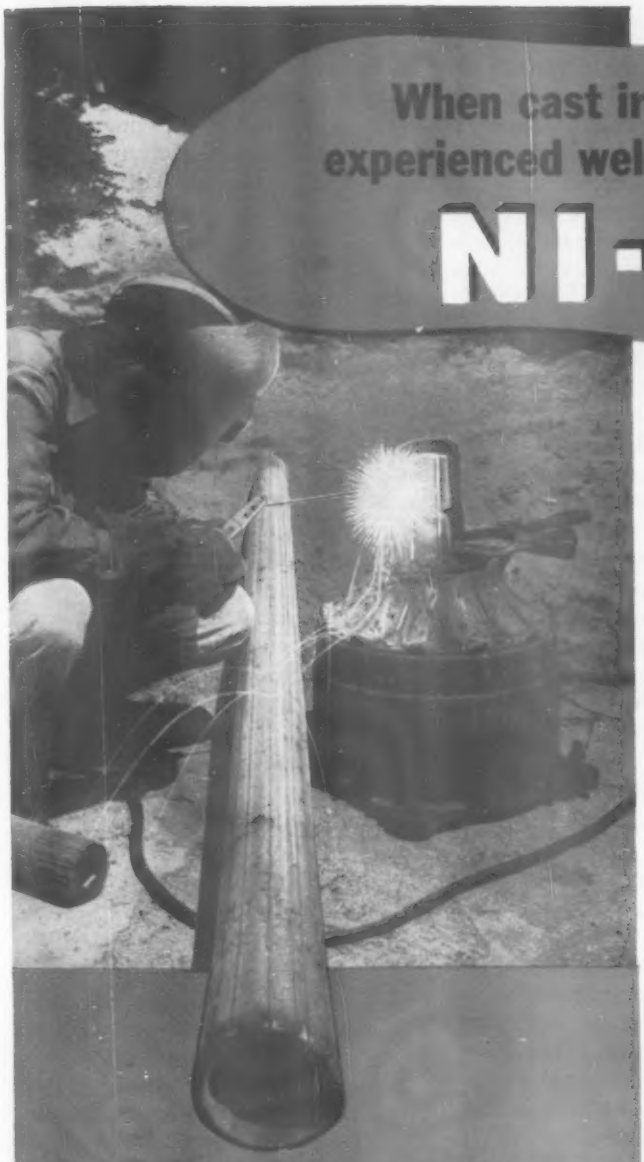
This comes right down to *you... for at stake is your chance for steady work, for better pay, for new things like television, and for more of the every-day things, like coal and clothing, of better quality and at less cost.*

By helping business get new and better tools, you will help yourself—and you will help build a more sound, more prosperous, better America.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

When cast iron calls for help . . . experienced welders call for NI-ROD



Repairing a 250-pound cast iron lamp post with 1/8" NI-ROD Electrode. The General Welding Service, Elmhurst, L. I., N. Y. find that NI-ROD gives the best results of any electrode they have tried in this service. NI-ROD gives such smooth bead contour that it is not necessary to grind welds flush. A new coat of paint completes the repair.

When emergencies arise and they can't bring the job to you . . . you can take NI-ROD* to the job.

NI-ROD can't be beat for on-the-spot cast iron repairs because it needs no coddling . . . seldom requires preheating or postheating . . . gives stable arc on AC or DC . . . and makes sound, *machinable* welds.

Typical example of NI-ROD's on-the-spot usefulness was the *Case of the Irreplaceable Lamp Post.*

A motorist, whose daring exceeded his skill, demolished a lamp post in Forest Hills Gardens, Long Island, N. Y. This was no ordinary lamp post. It was a work of art in cast and wrought iron, virtually irreplaceable, so repaired it *had* to be.

Mr. Patrick O'Brien, superintendent of the Forest Hills Gardens development, sent a call for help to Messrs. Thompson and Shannon of General Welding Service, Elmhurst, L. I. They arrived on the scene equipped with mobile welding generator and NI-ROD. Result? In short order, the precious lamp post was back on its feet, practically as good as new.

Lamp post mayhem is a fairly common occurrence in his bailiwick, reports Mr. O'Brien. But thanks to NI-ROD and the skill of General Welding Service technicians, the aristocratic lighting fixtures are being preserved.

In addition to its usefulness in all-around cast iron maintenance work, NI-ROD gives excellent results in repairing close-tolerance castings. NI-ROD minimizes the danger of warpage, and original dimensions can be preserved.

NI-ROD comes in 3/32", 1/8", 5/32" and 3/16" diameters. Order a five-pound package from your distributor—and see for yourself how NI-ROD takes the "fight" out of welding cast iron. *Reg. U.S. Pat. Off.

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EMBLEM OF SERVICE INCO NICKEL

(Continued from page 35)

method for most of these unusual applications.

A very good paper on the economies of hard-facing was prepared by J. J. Barry and Albert Muller, Air Reduction Sales Co. Mr. Barry, who read the paper, divided hard-facing alloys into four major groups:

Group I. Impact severe, abrasion moderate. Iron-base materials with less than 20% alloy.

Group II. Abrasion severe, impact moderate. Iron-base materials with more than 20% alloy.

Group III. Heat, corrosion, erosion. Chromium-cobalt-tungsten alloys.

Group IV. Extreme abrasion. Hard particles such as tungsten carbide or various borides or nitrides embedded in a low-carbon steel matrix.

Without recourse to some such table as this, various follies may be committed such as using a chromium-cobalt-tungsten alloy to hard-face a ploughshare. The expensive alloy actually gives less abrasion resistance than the original plain-carbon steel.

The convention's only paper on flame-hardening was given by J. R. Burg, The Baldwin Locomotive Works, who told what types of locomotive equipment lend themselves to this process.

Resistance Welding

The prize-winning papers in the RWMA contest made up most of the program for the two sessions on resistance welding. Characteristics of the three-phase dry-disk rectifier welder were enumerated in the interesting and important paper by C. E. Smith and R. H. Blair, of The Taylor-Winfield Corp. This gadget is something worth keeping in mind. The rectifier stack consists of a group of heavy copper plates, like sections of bus bars, assembled together on bolts with disks of magnesium and disks of copper-sulphide-coated copper inserted between the plates. This combination has the characteristic of permitting current to flow in only one direction, and thus three-phase a-c is converted to d-c for welding.

The copper sulphide rectifier possesses a negative resistance characteristic, which means that as amperes increase the internal resistance or impedance of the power pack goes down. This produces a welding machine with very desirable self-regulating characteristics. As the work resistance becomes lower in value, the current increases accordingly so that weld heat is not diminished.

The prize-winning paper by Raymond C. Jones, also of Taylor-Winfield, described a laboratory investigation made to determine the effect of welding variables, notably pressure, time and current, upon the strength and appearance of welds of cross wires. The experiments were restricted to single welds in wires of equal diameter, ranging in size from ⅛ to ½ in. Both cold-drawn and hot-drawn low-carbon steel wires were investigated. Each wire diameter was studied under three conditions of set-down: 15, 30 and 50%. Percentage of set-down was defined arbitrarily as the percentage of one wire diameter lost during the weld.

Messrs. R. M. Curran, P. Patriarca and W. F. Hess, all of Rensselaer Polytechnic Institute, contributed a triply-authored paper on the importance of temperature measurements in the establishment of optimum flash-welding conditions. This paper was read by Patriarca with discussion by Hess. The gist of it is that temperature measurements made during the flash welding of aluminum alloys indicate a correlation between the temperature distribution and process variables such that temperature distributions may be predicted mathematically from the welding conditions and thermal properties of the material. Conversely, welding conditions to produce a desired temperature distribution may be determined.

Professor A. R. Hard, State College of Washington, came all the way from his far-western state to present a paper on spot-weld shunting in 24ST Alclad. Shunting occurs only after a spot or so has been made; its effect is to permit a part of the current to run back to the previously made spot so that the second spot will be weaker than it should be. In his preliminary investigation, Hard attempted to compensate for shunting in single-row joints by using increased energy levels and found that this had a beneficial effect. Weld spacings of ¼, ½, ¾, 1 and 1½ in. were studied, using a manually operated indexing table to control the spacing. Wire buffed and chemically cleaned stock were also compared; wire buffing gives the greater surface resistance.

The first-prize paper of Frank G. Harkins, Solar Aircraft Co., discussed the development of spot-welding schedules for nickel and nickel alloys. Experiments in welding nickel and nickel-alloy foils of 0.002-in. thickness were described, and schedules were developed for welding dissimilar metal thicknesses such as 0.002 to 0.040 in. Mr. Harkins submitted tentative schedules for adoption by the Resistance Welding Committee.

Other resistance-welding papers described a study of the thermal resistance of a butt joint between two mild-steel cylinders 0.746 in. in diameter (W. B. Kouwenhoven, dean, school of engineering, and J. H. Potter, assistant professor of mechanical engineering, The Johns Hopkins University) and a series of tests made with projection welders (Wendell F. Hess, Wylie J. Childs and R. F. Underhill, Jr., of Rensselaer Polytechnic Institute).

Cutting Sessions

Five papers were presented at the two afternoon sessions on flame-cutting. One of these, by H. G. Hughey and R. B. Steele, Air Reduction Sales Co., described a new machine that will follow irregular surfaces, operate at high speeds and remain unaffected by high temperatures. This is accomplished by means of a flame which "feels" the work surface, so to speak. Any rise or fall of the surface is detected by the flame feeler, which promptly dispatches a message to an electronic control system that accurately positions the torch. Once the cutting tip clearance is adjusted for the initial or zero condition, the traverse of the torch across the surface is maintained automatically in correct height relationship to the work.

A paper on the stability of oxyacetylene flames was given by Lewis D. Conta, Air Reduction Research Laboratories. Mr. Conta's paper was a lengthy, somewhat technical review of the combustion of oxyacetylene mixtures, covering such topics

as flame propagation, transformation velocity, detonation waves, backfire, blowaway, flashback, etc.

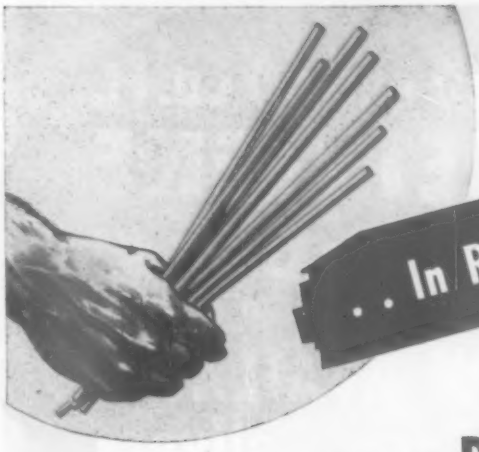
The widespread application of the powder-cutting process for stainless steels has aroused interest regarding the effects of this process on the corrosion resistance of the steels. A paper by C. R. Bishop and L. E. Stark, Union Carbide and Carbon Research Laboratories, Inc., described the results of tests performed to compare the effects of powder cutting on a variety of unstabilized and stabilized types of stainless steels. It was found that the severity of the heat-affected zone in unstabilized stainless welded by the manual arc or submerged-melt methods was not increased by beveling the edges by powder cutting prior to welding. Furthermore, heat effects could be minimized by means of water quenching applied simultaneously with the cutting.

George J. Strate, Air Reduction Research Laboratories, told about an inexpensive oxyacetylene machine designed to cut I-beams or H-beams of from 10 to 36 in. on a steel-mill roll line. This structural I-beam cut-off machine is a ram-type unit which mounts three torches. The I-beam is presented to the machine riding on the bottom flange. Two torches, mounted top and bottom, move horizontally to cut the top and bottom flanges perpendicular to the longitudinal axis of the beam. The third torch moves vertically from top to bottom and cuts the web section. All cuts match in the same plane to produce a continuously smooth cut surface.

Other types of specialized steel-mill cutting machines and controls to handle hot materials on or off the roll line were discussed by R. F. Helmkamp and A. H. Yoch, both of Air Reduction Sales Co.

Brazing, Metallizing

A. M. Setapen and W. D. Warren, respectively manager, engineering division, and metallurgist of Handy & Harman, presented data on a method of treatment which permits beryllium copper to be brazed with silver alloys flowing in the 1,145-1,200 F range with subsequent development of full hardness. Hitherto, the brazing of beryllium-copper alloys with low-temperature silver-brazing alloys has not been exten-



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sive, due principally to the belief that a reasonably high degree of hardness could not be attained.

The published recommended silver-brazing procedure combines brazing and solution treatment by joining beryllium-copper parts with an alloy that flows at 1,435 F. Messrs. Setapen and Warren contend that torch brazing can be performed with silver alloys flowing in the 1,145-1,200 F range, and the brazed assemblies subsequently aged to full hardness. With suitable refinements of the heating and cooling cycle, furnace brazing can also be performed without serious adverse effect on the hardenability.

Novel maintenance and production applications of metallizing were described by Knowles B. Smith, vice-president and general manager of Dix Engineering Co., Inc. These include the spraying of a controlled thickness of copper on carbon resistors and the application of sprayed metal to glass, ceramics, wood, fiber, plastics, cloth, paper and other materials not usually considered as bases for metallic coatings. With regard to cloth and paper, Mr. Smith declared that the mechanical adherence of the sprayed metal is controlled by the surface texture. A highly glazed paper or a tightly woven and sized cloth would not offer a good bond.

Two papers on automatic welding were presented at one of the final Friday morning sessions. Howard L. Miller, Republic Steel Corp., described automatic submerged-arc welding of 1-in. alloy-steel plates, and Cecil C. Peck, of Cecil C. Peck Co., discussed production tooling for automatic welding.

Ships and Railroads

The three sessions on ships included a morning session on ship design and an all-day symposium on ship structure research. The opening remarks at the latter event were made by Rear Admiral Ellis Reed-Hill, U. S. C. G., chairman of the Ship Structure Committee. Admiral Reed-Hill suggested new goals in safe shipbuilding and expressed hopes for research that would help achieve this end. Authors contributing to the symposium were: E. P. Kĕer, F. C. Wagner and M. Gensamer, The Pennsylvania State College; W. H. Bruckner and N. M.

Newmark, University of Illinois; C. E. Sims and H. M. Banta, Battelle Memorial Institute; A. Boodberg and Earl R. Parker, University of California; Noah A. Kahn and Emil A. Imbembo, New York Naval Shipyard. Their papers covered such highly technical subjects as fracture characteristics of ship plate, axial tension impact tests, development of weldable high-strength steels, effects of geometry and welding on the transition temperatures of high yield strength structural steels, etc.

The ship design session was less technical and dealt with more immediately practical problems. Papers were presented by Milton Forman, Battelle Memorial Institute, on hatch corner tests and factors affecting the notch toughness of steel; by E. M. MacCutcheon, David Taylor Model Basin, U. S. N., on riveted vs. welded structure; by L. F. Bledsoe, Newport News Shipbuilding & Drydock Co., on the repair of welded ships; and by T. W. Greene, The Linde Air Products Co., upon the evaluation of the effects of residual stresses.

Six papers on railroad welding were presented at two sessions. Two papers were devoted to Diesel locomotives: one on its production by H. S. Swan, American Locomotive Co., and the other on Diesel locomotive maintenance welding by R. L. Rex, Air Reduction Sales Co. Mr. Rex showed an array of interesting slides of damaged Diesels repaired by a variety of welding methods and techniques. As proof of what welding is able to accomplish, he pointed to the brazing of three cast-iron engine bases that saved the railroad about $15,000. Some other current welding practices are the rebuilding of Diesel bodies, and the reclamation of aluminum pistons, engine valves, cast-iron cylinder heads and bearings.

An equally good paper by J. Michne, New York Central System, discussed general welding practices in locomotive and car shops. Most of the material presented was based on the author's own experience. Subjects considered were types of equipment in general use, supervisory personnel, training system for operators, approved qualification test procedure, setting up of correct welding procedures, procedure control and final inspection.

Submerged-arc welding of freight

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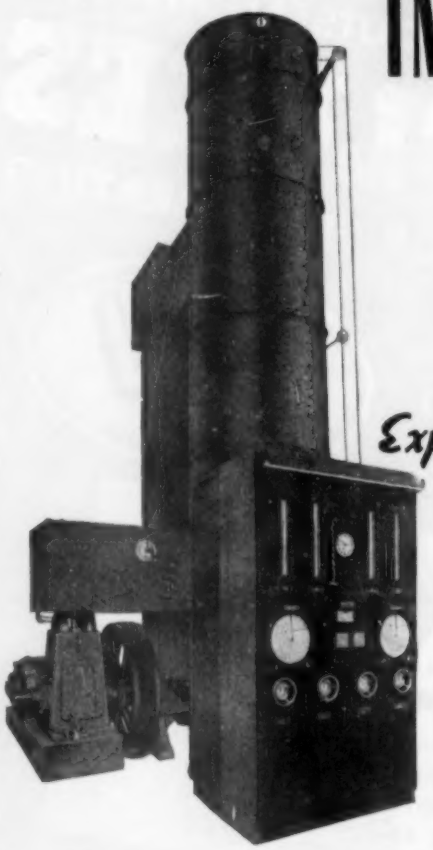

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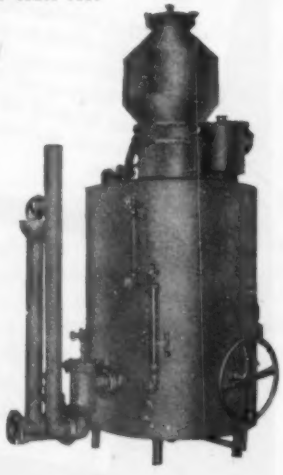

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cars was covered by E. A. Watson, of American Car & Foundry Co., and the submerged-melt and inert-gas-shielded welding of railroad cars by C. R. Strutz, The Oxweld Railroad Service Co. The Strutz paper pointed out that submerged-melt welding has been used for some time in the fabrication of car tanks, car underframes and side panels. Its applications have been greatly extended by the development of the more flexible semiautomatic welding head.

The inert-gas process is used extensively in the fabrication of corrosion-resistant car tanks of 2S and 3S aluminum. Also fabricated are condenser tanks of coach air-conditioning units, made of stainless steel or Everdur. Another broad field of application is found in the various furnishings of passenger cars such as stainless-steel smokers' stands.

The final railroad paper, by Howard L. Miller, Republic Steel Corp., was devoted to the welding of locomotive fireboxes, with special emphasis upon the welding of side sheets of creep-resistant 18% chrome steel (AISI specification No. 430).

Pressure Vessels and Piping

Storage tanks, pressure vessels and piping were lumped together in one session, at which four papers were presented. Fred L. Plummer, Hammond Iron Works, discussed field-erected aluminum tanks for the storage of chemicals, crude oils, etc. Since the coefficient of expansion of aluminum is nearly twice that of steel, distortion difficulties would be encountered if the tanks were constructed by the methods used for steel such as flame-cutting members to finished dimensions. Aluminum does not lend itself to the production of long, slender compression-loaded members, and it cannot be used in vessels to be subjected to temperatures of over 400 F. In case of fires, the aluminum shell may be expected to melt above the level of the liquid contained in the tank but fortunately not below that.

An interesting variety described by Mr. Plummer is a combined aluminum-and-steel tank for the storage of crude oils having high sulphur content. The roofs and roof supports of steel tanks used to store such crudes corrode very rapidly so

that there is an economic advantage in having the roof, roof supports and possibly the top shell ring of aluminum while the lower portion remains of steel. In such a tank, it is necessary to use rubber gaskets or similar precautions to prevent galvanic action at the contact surfaces between steel and aluminum. Provision must also be made during erection for the different coefficients of expansion.

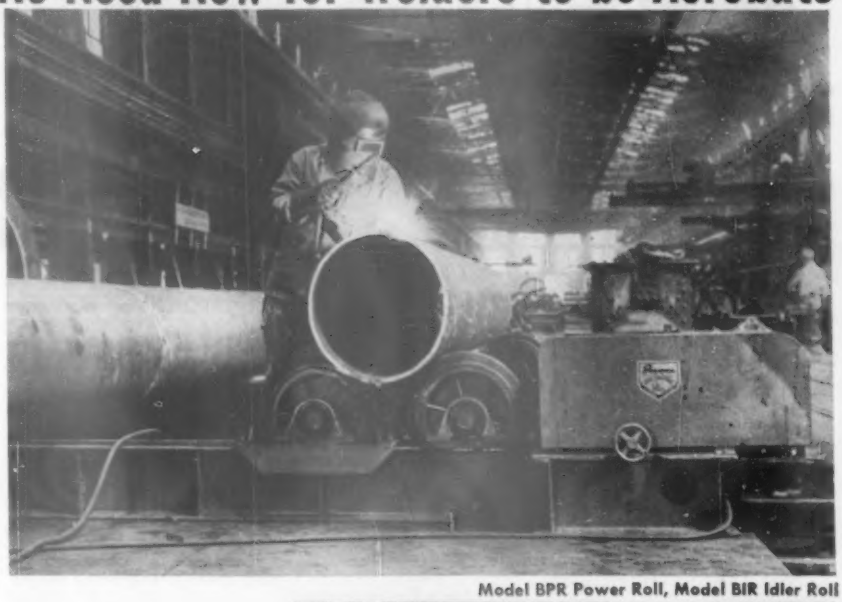
Sampling of welds in tanks and pressure vessels for quality control was handled in a paper by R. B. Lincoln, Pittsburgh Testing Laboratory. The sampling method can be used where radiographic equipment is not available or where it would be difficult to get to the other side of the wall to place the film. If the sample is small enough, this can be considered as a non-destructive test since only a minor portion of the joint is affected. Two types of equipment are available: a machine tool having a saw with spherical curvature that removes a boat-shaped specimen and the familiar trepanning or hole saw—a tubular saw with teeth on its edge. It is generally necessary to grind the samples before etching. Too much etching should be avoided as it tends to make the defect appear bigger than it actually is.

Either good or bad work will require a minimum of sampling. In borderline cases more samples must be taken in order to determine the acceptance or rejection of the vessel as a whole.

The piping end of this session was given to John H. Zink, Heat & Power Corp., Baltimore. Mr. Zink's business is heating, piping and air conditioning, and he is a strong believer in the oxyacetylene process for welding all piping up to 2 in. in diameter. Development of a multiple-pass technique for gas welding is badly needed, he thinks, to enable oxyacetylene welds to be made in larger pipe sizes. Such a technique would "bring a good competitor (gas welding) back to respectable standing." Pipe welding is still largely a manual operation and dependent upon the skill of the operator. Welding, however, is the preferred method in most high-pressure piping and in about 75% of the low-pressure piping.

The final paper in this very good session was prepared by a quartet

No Need Now for Welders to be Acrobats



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of authors: C. J. Osborn, Miss A. F. Scotchbrook, R. D. Stout and B. G. Johnston, all of Lehigh University. This was a preliminary report on an extensive investigation designed to compare various steels as to their relative tendency toward brittle behavior at low temperature.

Structural and Maintenance

The structural session included four papers: one on welded bridges by LaMotte Grover, Air Reduction Sales Co.; one on the fabrication of structural steel sections by submerged-melt welding by J. M. Tippett, The Linde Air Products Co.; one on flexible beam and girder connections in a large welded structure by Harry Greaves, The Atlantic Refining Co., and one on the plastic behavior of wide-flange beams by W. W. Luxion and B. G. Johnston, Fritz Engineering Laboratory, Lehigh University. The LaMotte Grover paper revealed that the use of welding in bridge construction has been extended to truss spans as long as 438 ft in an Australian structure, while welded continuous girder bridges have been built in Canada involving span lengths up to 180 ft and the use of girder sections as deep as 12 ft, the latter being composed of single thicknesses of flange material as great as 3 in. welded to 3/8-in. webs. Several state highway departments in the United States have welded girder bridges either under construction or recently completed.

Maintenance welding was represented by a steel mill (L. P. Elly, Bethlehem Steel Co.), by a chemical plant (Elvin M. Ratcliff, Ethyl Corp.) and by a paper mill (Jamison Moore, Union Bag & Paper Corp.). Mechanized welding operations such as the submerged-melt process are important to the steel mill; techniques and materials for combating abrasion and corrosion to the chemical plant. The Savannah, Ga., paper bag plant has found that the increased and improved use of cutting and welding has contributed materially to lower maintenance costs.

Farm Machinery

Once again Ernest J. Koop, of Koop Blacksmith & Welding Shop, came all the way from Bakersfield,

Calif., to present his views. Mr. Koop's specialty is the building of farm machinery, and he is a man of many practical ideas. Parts of farm machines are still in the horse-drawn era, he contends, with machine frames, sprocket drive shafts and axles drilled and punched so full of holes that half of their original strength has been sacrificed. A change to proper welded design would appear to be in order.

Steel makers can help by supplying certain adaptable shapes such as T-bars, raised-flange T-bars and wide-flange channels. These can be made into cutters, clevis bolts and clamps, long beams and frames, Wide-flange beams are very applicable to certain farm machinery that is now being made partially of wood.

A paper by G. J. Green and D. H. Marlin, Dravo Corp., on the fabrication of 277-cu-ft shipping containers from 14, 16 and 18 gauge mild-steel sheets, revealed the surprising fact that spot welds could be and were made through dry paint and sealing compounds. Strength was naturally lower than welds made on clean steel but was still above AWS specifications.

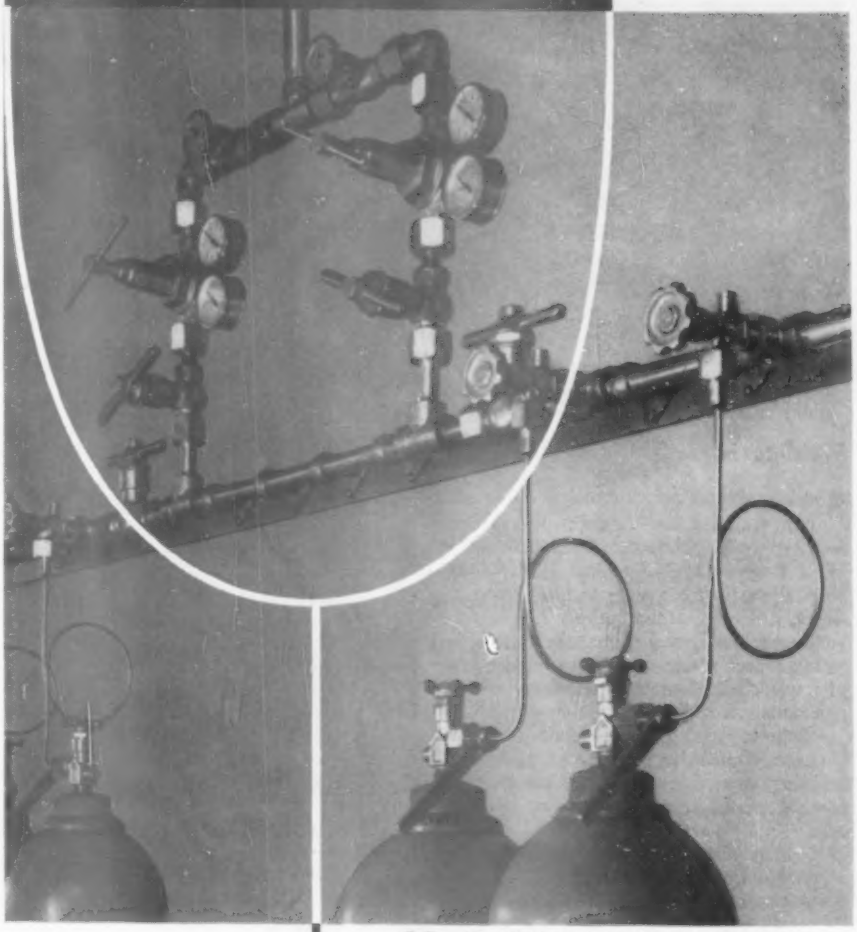
Ceramic and composite back-ups for grooved weld joints were discussed by Chester R. Austin and P. J. Rieppel, Battelle Memorial Institute.

The best back-up proved to be a copper bar washed with a coating composed of wollastonite (calcium silicate), clay and water in the respective relative weights of 56.8%, 3.4% and 39.8%. Granular ceramics, tamped into the bottom groove to a point just below the lands of the weldment, were not so satisfactory since the material would melt into the electrode slag and perhaps add to the difficulty of chipping. Tests were also made on commercial refractories (brick), refractory cements, ramming mixes, refractory ceramic materials and miscellaneous foundry materials, used in a loose state or as bars. None of these materials gave satisfactory results.

Lack of space, unfortunately, prevents mention of the papers presented at the sessions on high alloys non-ferrous, weldability, arcs and electrodes. A great deal of good research work was done.

It was, in every way, a truly excellent convention.

REGO*



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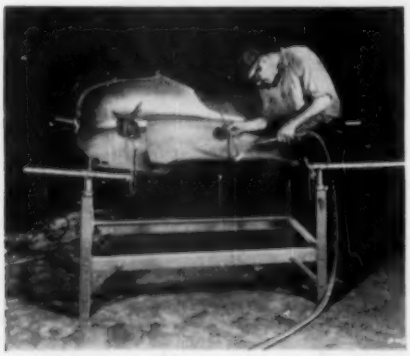


BODY REPAIR is faster and easier with new adjustable rack for straightening, filing, soldering and welding operations

Welding Rack

SPECIALLY built for automobile body repair work, a new flexible rack manufactured by BLACKHAWK MFG. Co., 5325 West Rogers St., Milwaukee 1, has four vertically adjustable arms to hold fenders, doors, radiators, etc. at proper height for welding. Horizontal arms are also adjustable and rotate over full 360 deg. A pliers is chained to the rack for convenience.

Frame of the rack is constructed of U-channels and strongly braced. L-shaped brackets are fabric-covered to protect painted surfaces, and swing in 180-deg arcs. Rack measures 59½ in. long by 28¼ in. wide. Low height is 30¾ in.; vertical arms elevate height by 11 in.

* * *

COMBINATION blast and spray gun cleans welds, prepares surfaces for tinning

Blast Gun

COMBINATION sand blaster and spray gun has been developed for production, cleaning and finishing in the metal-working field. Welds are said to be cleaned in seconds, leaving a surface suitable for loading and finishing. Fine bonding surfaces for tinning may also be produced.

Two attachments are supplied: an "abrading" case-hardened nozzle and a "solvent" nozzle for use with oil or chemicals. The abrading nozzle incorporates a safety tip that drops off when barrel needs replacement and a shield to stop and retain the bulk of ricocheting abrasive particles. Gun is equipped with a three pint container which locks with a quarter turn. ENGINEERED PRODUCTS, INC., 1224 Speer Blvd., Denver, Colo.

* * *

SAW BLADES up to 2 in. wide welded with new small flash-welder. With inserts will join wire, drill rod, bars, etc.

Flash Welder

PRODUCTION flash welder Model DBW-5 will join band saw blades up to 2 in. in width. Built by the DoALL Co., 254 North Laurel Ave., Des Plaines, Ill., this unit may be equipped with special inserts that will also enable it to join wire, drill rod, bars, flat stock, etc., up to ⅝ in. in diameter. Hence it can be used to salvage broken tools, weld extensions on drills, reamers, etc., or to join coils or rings.

A positive stop on the movable jaw prevents the jaws from making contact, which would result in a burned-out transformer. Positioning controls are in front for accessibility. Servicing of all switches is possible with removal of one panel.

The DBW-5 is equipped with a grinding unit for preparing material to be welded and to grind off flash after welding. A saw thickness gauge is included. The welder will perform etching operations when an etching pencil is connected to the welding jaw.

A lighter duty Model DBW-1 is also available for welding saw blades up to ⅜ in. in width.

ONE DIAL control panel is featured on new line of d-c welders. Series of outlets is provided for different diam electrodes

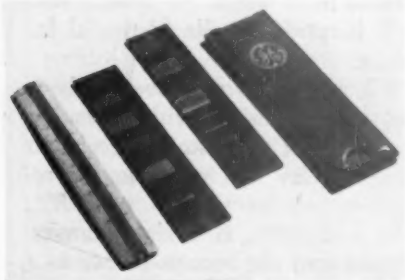
Arc Welders

METAL & THERMIT CORP., 120 Broadway, New York City 5, is bringing out a new group of a-c and d-c arc welders. Major design feature of the d-c models is a one-dial control panel that carries a series of outlets, each marked for an electrode of a different diameter. Operator plugs into proper outlet for electrode he wants to use, then dials for required minor adjustment in current.

The a-c units are featured by built-in power factor corrector; stepless current control; fan-forced ventilation; moderate open-circuit voltage; plug-in of electrode leads by tapered connector. These transformer-type welders are available in capacities of 150 to 500 amp.

Motor-driven d-c units are available in capacities of 150 to 400 amp, in compact 3,600-rpm model and in conventional 1,750-rpm type. Engine-driven units have capacities from 200 to 400 amps.

* * *



24 SURFACES depicted on new roughness scales for draftsmen, engineers, inspectors

Surface Roughness Scales

POCKET-SIZE surface roughness comparator for sight and feel comparison with various metal finishes is now available. Comparator is composed of two small metal rules, 6 in. long and 1¼ in. wide. One side of each scale is divided into 12 surfaces, depicting a total of 24. They are grouped into ten degrees of roughness. Each degree is identified by a number designating the nominal roughness in micro-inches.

Weighing three oz., including leather case, the scale will enable engineers and draftsmen to visualize, select and specify surfaces. Machine operators and inspectors may determine by sight and feel whether surfaces meet designated specifications. SPECIAL PRODUCTS DIVISION, GENERAL ELECTRIC Co., Schenectady 5, N. Y.

AIR JET on flux chipper cleans work surface. Has lever or push throttle

Flux Chipper

SMALL weld flux chipper has been put on the market by CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York 17. This general-purpose chipper has several new features, one of which is a positive air jet to clean off the work surface. Smooth throttle action is provided a new pulley-valve design.

Tool is shown peening weld on a tractor sprocket. Weight is approximately four lb, and length is slightly over 10 in. Tool is claimed useful for chipping in confined places, such as inside small tanks. Either a lever or push throttle is available, and equipment includes a chisel.

* * *

Respirator

INEXPENSIVE respirator, announced by AMERICAN OPTICAL CO., Southbridge, Mass., is the new R-2900 designed to protect against light concentrations of nuisance dusts in industrial and agricultural occupations.

Streamlined design allows unobstructed front and side vision. Filter is lightweight, inexpensive and replaceable. Retainer cup is light and durable. Face mask is molded from high quality rubber. Inhalation and exhalation valves prevent dust infiltration while allowing easy breathing.

* * *

Soldering Flux

NEW soldering flux, in concentrated fluid form, is called "Tin-Tite." It is sprayed on to the clean metal until the surface is wet, and both metal surface and solder are heated until the solder softens. The heated steel tins on contact with the melted solder, permitting the operator to tin and fill in one operation. A lasting bond is claimed with a feather edge that will not chip nor peel. REMONT MFG. CO., Lombard, Ill.

* * *

Soapstones

AIR Reduction Sales Co. has added soapstones, also known as talc crayons, to its line of welding supplies. They are useful for many purposes in the metal-working field, such as marking shapes for flame-cutters or lap joints for weldors. Stock handlers also employ soapstones for marking sheet metal before storage. Airco will market crayons of 3/16 by 1/2 by 5 in. size, packaged one gross to a carton. AIR REDUCTION SALES CO., 60 E. 42nd St., New York City.

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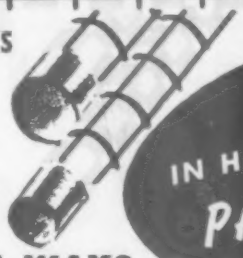

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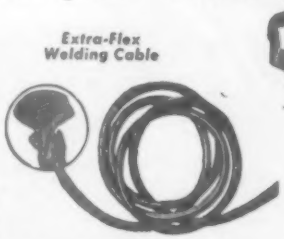

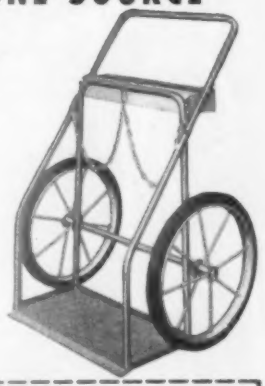

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NEW YORK 1, N.Y.

FOUR-WHEELED cylinder truck is said to afford easy steering, space for electrodes, etc.

Cylinder Truck

FOUR-WHEELED "welding car" has been developed by GLEASON CORP., DIVISION OF GLEASON STEEL CORP., 534 North Ninth St., Milwaukee 3, Wis. Operator does not have to carry any of the load; he only steers. Unit is 21 in. wide for passage through narrow aisles and doorways. It carries in tandem a 12 and a 9-in. diameter cylinder. There is room for a large stock of electrodes and a box for welding accessories. A fire extinguisher may be attached to the vertical standard. Swivel casters and 10-in. diameter rubber tired wheels afford easy rolling. Level platform is 5½ in. above floor.

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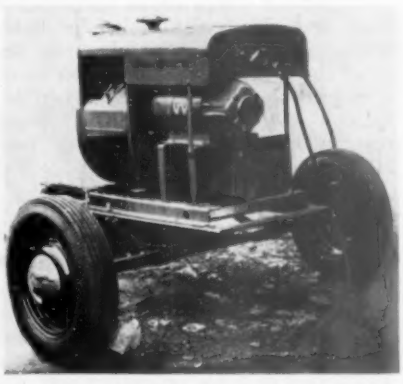
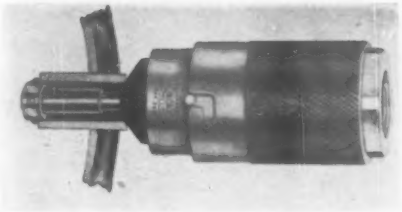


ENGINE-DRIVEN d-c welder has 250 amp capacity with 50% duty cycle

Engine-Driven Welder

NEW lightweight engine-driven d-c welder has been announced by WELDING EQUIPMENT DIVISION of GENERAL ELECTRIC CO., Schenectady 5. Weight is 660 lb for a minimum of 250 amp of current. The new welder may be transported on a pick-up truck. It is powered by a Wisconsin VF-4 air-cooled engine coupled by a V-belt drive to a G-E Type WD-3200 generator with 50% duty cycle.

The welder has a built-in auxiliary power outlet of 110 volts for the operation of lights and power tools. Overall length is 44⅛ in. It can be furnished mounted on a two-wheeled, pneumatic-tired trailer with a standard 62-in track.



SELF-SEALING test plugs for welded tanks, vessels. Sizes range from ¼ to 2 in.

Test Plugs

NEW TEST plugs and pressure-line filling connectors are equipped with expanding-head pull rods and are self-sealing. Requiring only several seconds to insert or remove, these plugs and connectors are designed to seal plain or threaded holes in flanged or fitted openings in tanks or boilers requiring hydrostatic or air testing.

Manufacturer states that with these plugs the testing pressure within the tank is utilized to actuate a piston with sufficient force to hold an effective seal. Stock sizes for ¼ to 2 in. pipe openings are available for standard flanges and are suitable for any pressure up to 500 psi. MECHANICAL PRODUCTS CORP., 168 North Ogden Ave., Chicago 7.

• • •

Low-Hydrogen Electrode

CALLED "Hobart No. 90-PL," a low-hydrogen coated electrode designed for welding high carbon, high sulphur and other hard-to-weld steels without underbead cracking is now available. Deposited weld metal is said to be sound with high ductility. Physical properties of this electrode are: tensile strength, 94,000 psi; yield point 85,000 psi, and elongation in 2 in. is 26%. It is available in 3/32, 1/8, 5/32, 3/16 and ¼ in. diameters for use with d-c welding current only. HOBART BROS. Co., Hobart Square, Troy, O.

• • •

Repeat Cycle Timer

A NEW cycle timer employs one radio-type vacuum tube and obtains its timing intervals by the discharge of two resistance-capitance combinations in which the resistances are independently variable over wide ranges. One operating cycle initiates the next without any mechanical parts or external operation. "Off" and "on" cycles are independently variable. A pushbutton permits the timer cycle to be synchronized with external equipment with which it may be associated. The timer is housed in a steel cabinet 6 by 6 by 6 in. All controls are on the front panel and consist of an off-on toggle, fuse, synchronizing push button, off-and-on and long-and-short time controls. The off-and-on controls are two rotable dials which increase either off or on periods with rotation clockwise. Long-and-short time controls switch the ranges of the off-and-on controls to provide longer intervals. G. C. WILSON & Co., 2 N. Passaic Ave., Chatham, N. J.

TAYLOR MADE by TAYLOR-WINFIELD

wheel housing seam welded in 15 seconds (RESISTANCE)

PRODUCT—Rear wheel housing for a new automobile design.

PROBLEM—To weld housing from stamped halves in one-half the time required with conventional or standard seam welder. Material is 20 ga. cold rolled steel.

TYPE OF WELDER—Special series T-W seam welder with dual, roller anti-friction heads and special air operated pivoting fixture.

PROCEDURE—Halves of wheel housing are placed in fixture. Following sequence is fully automatic. One operation of palm button sets up this cycle...(1) clamps work; (2) moves fixture to welding position; (3) brings welding heads down and heat on, as fixture starts to rotate. On completion of weld, fixture automatically returns to unloading and loading position and unclamps completed assembly.

COMMENT—This special seam welder is designed to fabricate wheel housings of such depth and shape as could not be economically or efficiently deep drawn from one piece to like dimensions.

RESULTS—A production of 150 complete wheel housings per hour with an average welding time of 15 seconds per assembly.

Our monthly publication "Weld-It" shows many production short cuts by resistance welding. Request it using your company letterhead.

THE TAYLOR-WINFIELD CORPORATION
WARREN, OHIO, U. S. A.

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RESISTANCE WELDERS

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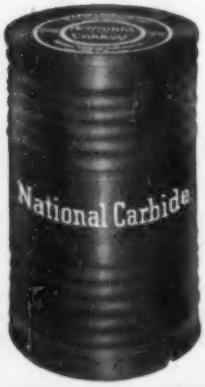

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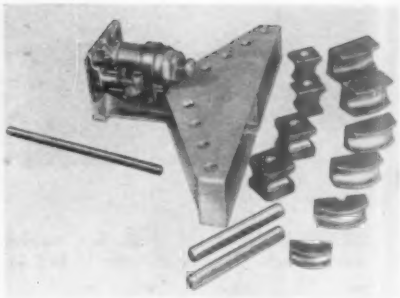
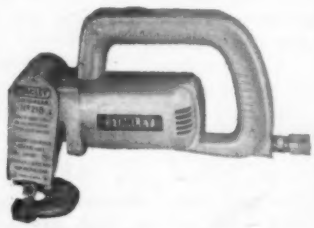


LIGHTWEIGHT hydraulic pipe bender has welded frame, bends 2½ in. pipe

Pipe Bender

LIGHTWEIGHT, portable hydraulic pipe bender has an all-welded 30 in. steel frame. Combined weight of the jack and frame is 83 lb. Removable hydraulic jack simplifies the service problem and can be used for many other purposes. Open-jaw construction speeds up production. Bender comes equipped with ¾, 1, 1¼, 2 and 2½ in. dies. ELECTRIC CORD CO., 30 Church St., New York 7.

* * *



LIGHTWEIGHT metal shear claimed to cut 18-gauge steel at 15 ft per minute

Portable Shear

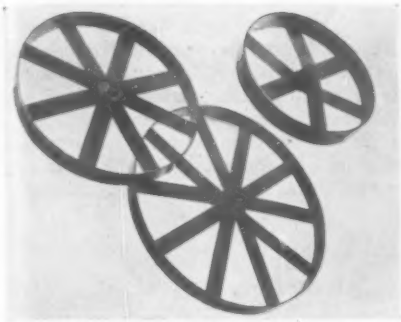
STANLEY ELECTRIC TOOLS, New Britain, Conn., announces the No. 218 "Uni-shear". A portable tool weighing 4¾ lb, it is claimed to cut 18-gauge hot-rolled mild steel at a speed up to 15 ft per minute.

Blade action "feeds in" the work so that little effort is required by operator, who can cut either straight lines or curves. Ball and roller bearing construction, automatic lubrication of plunger from gear housing and convenient slide-operated switch are features. The tool is furnished with rubber-covered three-wire cable, wrenches, clearance gauge and supply of lubricant. It is built for 115 volts operation, though other voltages may be supplied.

* * *

Solderless Terminals

A NEW plug-in-type terminal for 16-4 wire size provides an easy, convenient method of installing or replacing connections on leads in electrical equipment. These "Shur-Plug" terminals may be applied by pneumatic hand tools or by a foot or power press. Resulting connection is said to have high electrical conductivity and corrosion resistance. AIRCRAFT-MARINE PRODUCTS, INC., 1689 N. 4th St., Harrisburg, Pa.



ALL-WELDED wheels for cylinder trucks feature close-fitting bearing surfaces

Welded Wheels

ALL-WELDED wheels of simplified design for hand trucks and other material-handling equipment are available for general distribution. These wheels have been adopted as standard equipment on all Adams welding cylinder trucks unless specifications indicate otherwise.

Wheels are made in 10, 14 and 18 in. diameters to fit standard ⅝ or ¾ in. axles. Axle holes are accurately machined to size in a special jig which holds the entire wheel. ADAMS MFG. & SUPPLY CO., 1522 N. Indiana St., Los Angeles 33.

* * *

REVERSING contactor controls a-c, d-c motors on cranes, hoists or speed changers

Reversing Contactor

COMPACT a-c and d-c reversing contactor controls small motors used on hoists, overhead doors, speed changers, etc. Contactor consists of double magnet frames and contact blocks mounted with two three-pole armature assemblies.

These devices are suitable for use with a-c polyphase motors rated not more than 1 hp and with a-c single phase and d-c motors rated not more than ¾ hp. SQUARE D CO., INDUSTRIAL CONTROLLER DIVISION, 4041 North Richards St., Milwaukee 12.

* * *

Submerged-Arc Bronze Wire

USERS of submerged-arc welding can now obtain a bare bronze wire in coils satisfactory for overlaying of large steel areas for bearing surfaces or to provide wear and corrosion resistance. The new wire is the familiar "Ampco-Trode 10," supplied in coils, in ⅛-in. and 3/16-in. diameter sizes. The wrapped coils have a 22-in. inside diameter and are wound lefthand to turn off a vertical reel counterclockwise. AMPCO METAL, INC., Milwaukee.

(*Continued on page 98*)

ANOTHER JOB

Photo Courtesy of The Elwell-Parker Electric Company

for SPEER CARBON ELECTRODES . . .

Carbon Arc Welding Fuses Copper Coils Permanently

Use Speer carbon electrodes for welding copper armature coils to commutator bar neck slots and increase motor life. Carbon arc welds stay firm even when motor overheats—outlast solder connections—speed armature assembly.

By using Speer electrodes in your carbon arc welding operations you get carbons that have high current capacity. This characteristic gives you an even, steady burning arc at all times with less spluttering and spindling waste. Speer carbon electrodes are harder by 22%—are made to "take" the hard, continuous pounding of automatic welding machines. You get 13% more welds per inch with Speer—they last 33% longer.

Try Speer for all your carbon arc welding operations and watch your production and efficiency curves climb . . . Send for a trial lot today.

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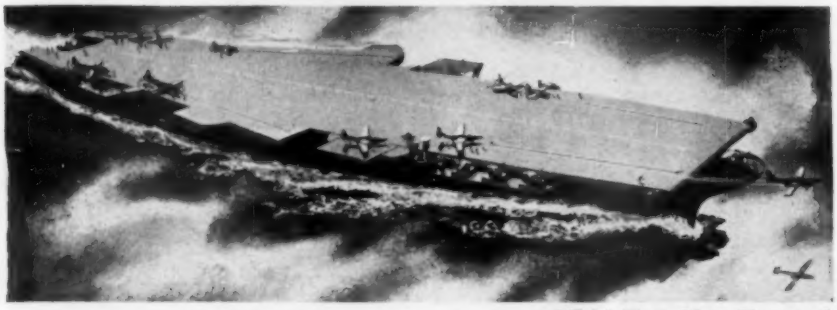
News of the Industry



—Official U. S. Navy Photograph

JOB FOR WELDING will be provided by the U. S. Navy's 65,000-ton flush-deck aircraft carrier when it is built by the Newport News Shipbuilding and Drydock Co., Newport News, Va. This artist's conception reflects the Navy's present design plans. Largest American naval vessel to be constructed, the carrier will be 1,090 ft. in overall length. Waterline beam will be 130 ft. and maximum fixed width 190 ft. Speed will be 33 knots

Titanium Alloy Purchased By National Lead Co.

NATIONAL LEAD Co. has purchased Titanium Alloy Mfg. Co. Main offices of the company at 111 Broadway, New York City, and its plant at Niagara Falls will be operated as a division of National Lead Co.

The Niagara Falls plant produces compounds of zirconium for the ceramics industry and titanium alloys for the manufacture of electrode coatings and other uses in the metal industries.

• • •

Nickel Tubes Available In Double Prewar Sizes

SEAMLESS tubes and pipes of nickel, Monel and high-nickel alloys are being produced by The International Nickel Co., Inc., in diameters up to 9¼ in. Before the war the largest size that could be obtained was 5 in. A 4,000-ton extrusion press, used for the production of rotating shell bands during the war, is now forming nickel alloy pipes in large diameters and lengths up to 12 ft. These shapes can be further cold drawn into seamless tubing 8 in. in diameter with wall thicknesses up to ¾ in.

• • •

Aluminum Plant Opened at Eddystone, Pa.

VANADIUM CORP. OF AMERICA has opened an aluminum alloy plant at Eddystone, Pa., under the supervision of Thomas N. Peck, director of the corporation's aluminum division.

Aluminum forms and shapes will be supplied to the industry and to the company's own ferro-alloy plants at Bridgeville, Pa., and Niagara Falls, N. Y.

Decision Announced On Welding Jurisdiction

IMPORTANT decision in one of two jurisdictional disputes stemming from welding operations has been announced by the Joint Board for the Settlement of Jurisdictional Disputes in the construction industry. The disputes settled involved the preheating and stress relieving of welds on high-pressure piping. No decision has yet been announced on the other dispute, involving operation of gasoline engine-driven arc welders.

Decision on the preheating and stress relieving of welds provides that: (1) Installation of induction preheating and stress-relieving equipment, including the wrapping of coils, is the work of members of the International Brotherhood of Electrical Workers. (2) Installation of manufactured resistance coils is the work of the Plumbers and Steamfitters Union. (3) Operation of preheating and stress-relieving equipment and instruments for pipe welding is also the work of the steamfitters.

The issue was brought before the joint board by Gibbs & Hill, Inc., New York contractors, and grew out of a dispute between the two unions on a power plant being built at San Antonio, Tex. On this job, the I.B.E.W. was operating the equipment covered in Point 3 and the steamfitters were wrapping the coils, covered in Point 1. The decision exchanges the work done by the two unions.

The board machinery was put into effect in May, 1948, in an agreement between the AFL Building and Construction Trades Department and a number of contractor associations whose members employ building trades crafts. Any contractor employing AFL building trades workers may utilize the plan if he is willing to accept the final decision as binding.

Members of joint boards are appointed for each dispute from a standing pool of AFL and contractor representatives. John T. Dunlop, Harvard University professor, sits as impartial chairman of all boards. This is the third decision handed down by the joint board, the first covering installation of copper pipe and fittings in breweries and the second, steel decking.

• • •

Electric Welding Meeting At Detroit Dec. 6, 7, 8

ELECTRIC welding conference sponsored by the American Institute of Electrical Engineers at Detroit's Rackham Memorial Building on Dec. 6, 7 and 8 will offer a chance to hear papers of wide interest in arc and resistance welding.

Arc welding sessions on Monday, Dec. 6, will cover such topics as "Radio Interference Problems in Welding," and "Problems in Argon Arc Welding of Thick Aluminum Plate." Tuesday resistance-welding papers will cover subjects such as "Recent Advances in Single-Phase Welding" and "Three Phase Welders, Metallic Rectifiers."

Power application papers on Wednesday will discuss, among other items, "Dummy Loads Applied to Large Industrial Welders to Reduce Voltage Fluctuations"; "User Power Supply Problems" and "Welding Calculations—Effect of Conductor Configuration in Overhead Lines."

A Tuesday evening session on maintenance of resistance welding equipment will be open to the public without registration fee. Detroit section of the American Welding Society and the Industrial Electrical Engineer's Society of Detroit are cooperating with the AIEE in presenting the conference.

• • •

Airco Subsidiary Changes Name

AIRCO EXPORT CORP. has changed its name to Airco Corp. (International) effective as of October 1. Besides handling all exports of the Air Reduction Co., Inc., subsidiaries, it also offers for distribution the products of U. S. Industrial Chemicals, Inc.; Sharples Chemicals, Inc.; the stainless, electrical and special alloy steel products of Allegheny Ludlum Steel Corp. and the CO_2 plants produced by The Girdler Corp.

• • •

A. O. Smith Division Does Record Business

RECORD volume of $16,000,000 was established by the pressure vessel division of the A. O. Smith Corp., Milwaukee, in the fiscal year ended July 31.

Production included solid and multilayer wall vessels ranging from small diameters to large units that could only be shipped by barge. Many vessels were equipped with corrosion-resistant alloy-steel liners or lined with glass fused to steel.

Alterations and improvements are under way in the company's vessel plants in Milwaukee, Houston and Los Angeles.

AIR-MINDED welders traveled in one day from Appleton, Wis., to Pasadena, Calif.

24-Hour Welder Delivery Wisconsin to California

FOUR 700-lb inert-arc welders were given 24-hour delivery recently from Appleton, Wis., to Pasadena, Calif. The customer telephoned from California late in the afternoon for rush shipment and the four welders left the Miller Electric Mfg. Co., at 5:30 p.m. by direct truck line to the Chicago airport. They left Chicago at 5:30 a.m. on the following morning via American Airlines air freight and were unloaded in Los Angeles at 4:15 p.m. the same day. That is rush service with a vengeance.

For better customer service, Miller Electric stresses the use of air freight to distant points.

* * *

Two New Salesmen Join Welding Engineer Staff

THOMAS H. BARRY and C. H. CLARKE recently joined the staff of THE WELDING ENGINEER as western and eastern managers, respectively. Mr. Clarke's headquarters are in New York City, and Mr. Barry is in the Chicago office. Mr. Clarke replaces T. E. Depew, who has retired after 24 years with the magazine. Mr. Barry takes over from J. H. Allen who now represents McGraw-Hill publications in Dallas, Tex.

Mr. Barry is a 1941 graduate of Marquette University. He was called to active duty with the Marines that year. While fighting with the 1st Marine Division on Guadalcanal, New Guinea and New Britain, he was twice wounded. In January, 1947, he resigned from the Marines with the rank of captain, and is now a major in the reserve. Since 1947 he has been with the sales staff of two McGraw-Hill electrical publications. He is married and has two children.

Mr. Clarke received a B. A. in 1939 and an M. B. A. in 1941 from the University of Michigan. He was in the Army five years as a special agent in the security and intelligence division of the War Department. After his Army service, he was with an investment banking house in New York until he joined McGraw-Hill in September, 1947. He is married and has one child.

Multi-Pic —THE FIRST REAL IMPROVEMENT IN WELD HAMMERS

NOW EQUIPPED WITH Repeater Brush

THAT WEARS AND WEARS AND WEARS AND WEARS

Multi-Pic is the improved weld hammer with 5 separate pic-pointed tool steel heads locked between free floating guide plates. Each single stroke of Multi-Pic gives five surface cleaning blows. The five picks adjust themselves automatically to the varied surface of any concave, convex or irregular shaped weld and clean quickly, easily, with fewer blows. Pic points are hardened, tempered tool steel which lasts indefinitely and can be resharpened.

Repeater Brush whisks away loosened slag, oxides and rust in a jiffy. The unique design makes it easy to reach into the deepest corners and crevices. The crimped oil hardened wire brush is provided with five quick and simple adjustments to compensate for wear and lasts five times as long as an ordinary brush.

Multi-Pic is supplied with double 5-pic pointed ends or with dual 5-pic and 25-pic pointed ends as illustated with or without the Repeater Brush. Extra Brushes—three in a carton.

ORDER FROM YOUR DEALER TODAY!

Try Multi-Pic in your own shop—on your own work. You'll welcome the quick, cleaner work of this new weld hammer which follows the contour.
If your dealer cannot supply you, write us for descriptive folder and name of nearest supply house.

Patents Pending.

BERNARD
WELDING EQUIPMENT CO.
741-743 East 71st Street • Chicago 19, Illinois

Welding IS EASIER, MORE PROFITABLE with TRINDL ARC WELDERS

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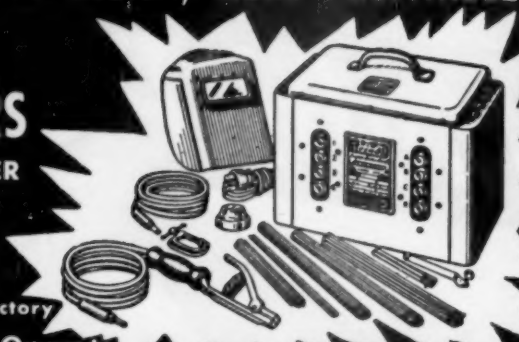
MODEL 125A WELDER

A Big Money Saver For Any Shop

Only $69.50 F. O. B. Factory



Complete-Ready-To-Operate

SAVES TIME • REDUCES COSTS • INCREASES PROFITS!

This exclusive, easy-to-operate TRINDL WELDER is a big saver for any shop . . . MODEL 125A is ruggedly built . . . Can easily be carried right to the job and connected to any convenient properly wired 110 volt 50-60 cycle AC supply line . . . With it you can BUILD OR REPAIR auto and home appliance, farm implements and tools . . . Fabricate special shop equipment, jigs and fixtures out of prime or scrap sheets, bars and tubes and do hundreds of other repair and construction welding jobs when you need them and as you want them done. MODEL 125A has 16 heat stages ranging from 20 to 125 amps, handles 1-16" to 5-32" rods . . . Comes Complete Ready to Operate—Nothing Else to Buy. Also available for 220 and other voltages at slight additional cost.

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• • •

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THE WELDING ENGINEER

330 W. 42nd St. New York 18, N. Y.

STRAIN GAUGES (spots on tank) were used to determine stresses in this 400,000-gal "Hortonsphere" at East Chicago, Ind.

Strain Gauges Replace Theoretical Analysis

DETERMINATION of shell stresses near the support of a 48-ft diameter welded spherical tank using bonded resistance-wire strain gauges has been found to be a practical substitute for theoretical analysis.

This second investigation of stresses in "Hortonspheres" was conducted by Chicago Bridge & Iron Co. engineers L. P. Zick and C. E. Carlson, whose findings were reported to the Society for Experimental Stress Analysis and will be published in SESA proceedings, Vol. VI, No. 2.

The tank was built at East Chicago, Ind., for Cities Service Oil Co., to store 400,000 gallons of volatile petroleum products at a working pressure of 60 psi.

Load transfer from the shell to the tubular column support is effected by about equal shearing stresses acting along the vertical portion of the intersection of column and shell. It was found that the shell in the region of the column tested was compressed vertically when the tank was filled with water but reversed to tension when a 60 psi test pressure was applied.

• • •

New R-W Manufacturer Operates in Grand Rapids

GOODRICH WELDING EQUIPMENT CORP., 117 Sheldon Avenue, S. E., Grand Rapids 2, Mich., was recently formed to manufacture resistance-welding equipment. The new company is making a line of welding transformers; spot, flash, projection, seam and butt welders; welding presses and dies; welding jigs and fixtures; built-to-order welded fabrications.

Officers are: Earl F. Goodrich, president; Jerry Greene, vice-president; W. H. Carrigan, secretary-treasurer; M. W. Skinner, plant manager; Frederick J. Randall, chief sales engineer; and H. J. De Witt, engineer. Mr. Goodrich has had 21 years welding experience with General Motors Corp. The other officers have had many years' engineering, designing and production experience in both large and small firms.

THIS LAD'S FIRST WELD CAN BE GOOD!

And—Most any man in your shop can make good welds—This Quick, Easy Way!

All-State low-temperature welding alloys have eliminated the hard-to-learn control of a puddle of molten base metal. What's more—they save up to 50% of your gas bills, and save on time, materials, preparation, and finishing. Turn to **All-State, the Low-Temperature Welding Alloys** . . . learning how to use them takes little more than getting in touch with an All-State distributor.

Here are some of them:

General Welding Supply Co.,
Mineola, N. Y.
Industrial Gas and Welding Labs.,
Schenectady, N. Y.
W. F. Kinsey Associates,
Wilmington, Calif.
Shasta Industrial Supplies,
Redding, Calif.
Sierra Oxygen Co.,
Reno, Nev.
Ralph H. Smith,
Lakeport, N. H.
Walter Smith Battery and Welding Service,
Kingston, N. Y.
The Smithweld Co.,
Houston, Tex.
Solder Supply Co.,
Boston, Mass.
Spokane Oxygen Service,
Spokane, Wash.
Southern Oxygen Co.,
Washington, D. C.
Southern Oxygen Co.,
Kingsport, Tenn.
Southern Oxygen Co.,
Philadelphia, Penna.
Southern Oxygen Co.,
Bladensburg, Md.
Stuart Oxygen Co.,
San Francisco, Calif.
Stuart Oxygen Co.,
Oakland, Calif.
Stuart Oxygen Co.,
Berkeley, Calif.
Stuart Oxygen Co.,
Los Angeles, Calif.
Sutton-Garton Co.,
Indianapolis, Ind.
Sutton-Garton Co.,
Ft. Wayne, Ind.

More will be listed in ads to follow.

ALL-STATE WELDING ALLOYS CO., Inc.
98 WEST POST ROAD • WHITE PLAINS, N. Y.

Titanium Metal Now Being Produced

PILOT unit for producing pure titanium has been placed in operation at the Newport, Del., plant of the pigments department of E. I. Du Pont de Nemours and Co., Inc. A capacity of 100 lbs daily has been reached. Purpose is for commercial exploration; small samples will be sent without charge to industrial and university laboratories.

Titanium is a silver-white metal, corrosion-resistant and has a melting point of 3,140 F. In strength and corrosion resistance, it is comparable to stainless steel but weighs about half as much. It is less than twice as heavy as aluminum, but several times as strong in bars of comparable dimensions.

Titanium is the world's seventh most common metal; it is more than 100 times as plentiful as copper, zinc or lead. Nevertheless, metallic titanium is so new that little is known about what it will do. The indications are, however, that it can be used where a high ratio of strength to weight is needed.

Large quantities of rutile and ilmenite, the ores from which titanium comes, have long been used for paint pigments and electrode coatings.

• • •

Fire Underwriters Approve Use of Aluminum Ducts

NATIONAL BOARD OF FIRE UNDERWRITERS has approved the use of aluminum in air conditioning ducts, warm air heating, air cooling and ventilating systems.

Cadmium or zinc coated hardware and fittings are recommended for the fabrication of such aluminum work. Copies of the 1948 NBFU pamphlet No. 90 may be obtained from the NBFU offices at 85 John St., New York City, 222 West Adams St., Chicago 6, or Merchants Exchange Bldg., San Francisco 4.

• • •

Canadian Firm Sells Oxygen Plants to Industries

"Make your own oxygen" is a new twist in the industrial application of this gas. Oxygen plants called "Oxytons" capable of producing 300 tons of oxygen daily are being built by the Canadian Liquid Air Co., Ltd. One of them was recently ordered by The International Nickel Co. of Canada, Ltd., for its plant at Copper Cliff, Ont.

• • •

Skating Rink Rebuilt With Welded Iron Pipe

A NETWORK of 70,000 ft of 1¼-in. wrought-iron pipe had to be welded in order to rebuild the St. Paul, Minn., auditorium skating rink. Each pipe in the grid was welded to 6 and 8 in. headers.

The pipe network was air tested for 48 hours and then embedded in a 6-in. slab of concrete. Brine circulating through the pipes freezes the water above them into a smooth skating surface. The rink is the second largest in the country.

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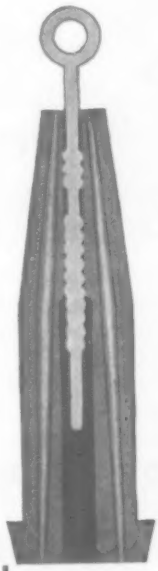
The Last Word in

Tip Cleaners

HANDY METAL CASE WITH

DRILL SIZES ENGRAVED ON BACK



Separation between serrations an exclusive Thermo identifying feature.

Saves more tips, more man hours and insures greater efficiency. The only tip cleaner with uniformly rounded, non-scratching cleaning ridges, manufactured through an exclusive Thermo process.

Standard set of 12 cleans 27 drill sizes. Large size set of 9 cleans 19 drill sizes.

THERMACOTE CO.
Newark, N. J. **Chicago, Ill.**
Los Angeles, Cal. **Portland, Ore.**

A USEFUL BOOK FOR THE WELDOR

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ITS QUESTIONS And ANSWERS

By T. B. JEFFERSON

Editor, *THE WELDING ENGINEER*

500 QUESTIONS—each answered clearly and understandably in this informative book. Answers the most important everyday questions of every man interested in welding.

Questions were carefully selected and screened from the most frequently asked by weldors about welding, cutting, materials, flame treating, inspecting, etc. Novice and expert alike can get a lot out of this book. It's easy to read, yet contains a fund of information. By using the handy index you can make this book very useful for quick answers to the questions that come up in your daily work.

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THE WELDING ENGINEER

330 W. 42nd St. New York 18, N. Y.

J. H. Deppeler Opens Consulting Offices

Forty years' welding experience has culminated in the opening of a consulting engineering office by J. H. Deppeler, well known as chief engineer of Metal & Thermit Corp. Mr. Deppeler has obtained a leave of absence from Metal & Thermit, but will continue as consultant to this firm, with which he has been associated since 1912. His new office is at 36 W. 40th St., New York City.

A founder of the American Welding Society, Mr. Deppeler was also its second president. He is currently chairman of both the Filler Metal Specifications Committee and Sub-Committee on Iron and Steel Arc Welding Electrodes. In 1944 he was awarded the Samuel Wylie Miller Memorial Medal and named as an honorary member of AWS.

Mr. Deppeler is a fellow of the American Society of Mechanical Engineers and chairman of the welding committee of the ASME Boiler Code Committee. He has had much to do with broad applications of thermit welding and did important work in the development of shielded-arc electrodes. He is a graduate of Stevens Institute of Technology, class of 1906.

• • •

Joint Committee Announces Electrode Specifications

Four tentative specifications for arc-welding electrodes were recently completed by the Committee for Filler Metal, jointly sponsored by the American Welding Society and the American Society for Testing Materials. Three of these are revisions.

"Tentative Specifications for Mild-Steel Arc-Welding Electrodes" and "Tentative Specifications for Low-Alloy Steel Arc-Welding Electrodes" represent a division of the old iron and steel electrode specification. Mild-steel specifications include all classifications in the E-60 series intended for welding mild steel. The low-alloy group includes all classifications in the E-70, E-80, E-90 and E-100 classifications intended for welding low-alloy, high-tensile steel. In both of these, classifications have been added to cover "low-hydrogen" electrodes.

Specification requirements have also been rearranged so that provisions concerning "classification and acceptance" such as test results, standard size and lengths, etc. are grouped together. As a further aid, each specification contains a guide to the classifications.

"Tentative Specifications for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes", first issued in 1946, has been expanded to include 40 classifications covering 85% of the stainless electrodes in use. There are ten series of four classifications each, including E-308, E-309, E-310, E-316, E-317, E-330, E-347, E-410, E-430 and E-502, which parallel the base metals of similar AISI numbers.

"Tentative Specifications for Copper and Copper-Alloy Metal-Arc Welding

Electrodes" is the first in a series of specifications to be issued for copper and copper-alloy filler metal. It includes classifications for copper, phosphor-bronze, copper-nickel, copper-silicon and aluminum-bronze materials.

Copies of the above tentative specifications are available at 25c each from the American Welding Society, 33 West 39th St., New York City 18, or The American Society for Testing Materials, 1916 Race St., Philadelphia 3.

* * *

New Tube-Forming Process Announced by Federal

FEDERAL MACHINE AND WELDER CO., Warren, O. announces a new process for forming of tubular sections by a combination of electric current and pressure. This process, originated by the Westin brothers, requires a heating transformer, dies, a mechanism for holding and rotating the tube and either a means of feeding the tube into a split-cavity type die or a means of feeding the two die segments at right angles to the axis of the tube.

Two halves of the split die are insulated from each other and connected to opposite sides of the heating transformer. Tube blank is secured in the chuck and simultaneously rotated at low speed and fed into the die cavity by mechanical or hydraulic means. As tube enters the die, current flows from one die segment through the tube to the other die. Resistance of the tube to flow of current causes it to heat rapidly and form to the shape and diameter of the die cavity.

Extruding operations are also possible by using the dies to heat the tube before forcing it through another die. Some expected applications for the new process are the forming of steel gas cylinders, upsetting sections of tubing to increase wall thickness, sealing tube ends, necking down tube sections, etc.

* * *

Foundation Elects Officers, Presents Annual Reports

ENGINEERING FOUNDATION has elected Joel D. Justin, Philadelphia consulting engineer, as chairman at its annual meeting in New York City on October 25. Dr. Boris A. Bakhmeteff, consulting engineer and professor of civil engineering, Columbia University, was chosen vice-chairman. Re-elected officers include Dr. Edwin H. Colpitts, formerly vice-president of the Bell Telephone Laboratories, as director and John H. R. Arms as secretary. Among those to continue terms on the executive committee is Dr. A. B. Kinzel, vice-president of the Union Carbide and Carbon Research Laboratories, Inc.

Reports were made on eighteen research projects aided by the foundation during the past year. Projects were concerned with studies in welding, hydraulics, alloys of iron, properties of gases, riveted and bolted structures and properties of metals at different temperatures.

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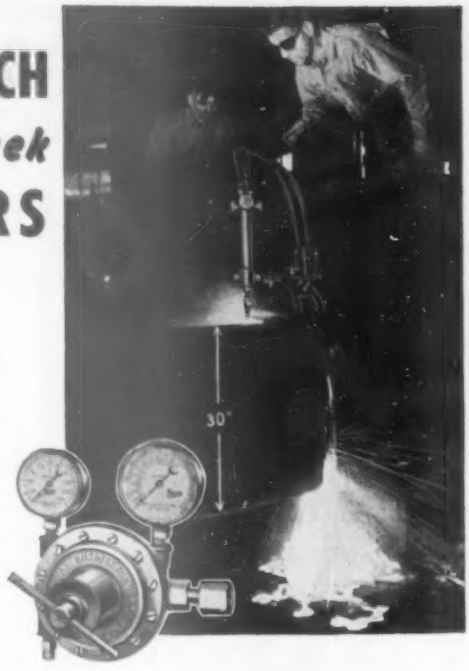

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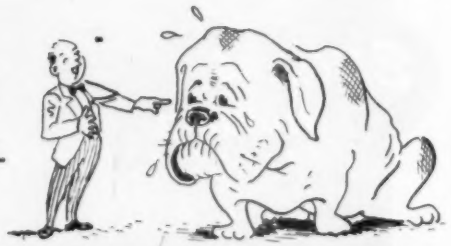

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The piping was laid over the original base of the floor, which had been covered with two layers of waterproofed tar and one of zinc sheeting.

Some 3,000 threadless black malleable couplings 1¼ in. in size, made by the Stanley G. Flagg Co., Inc., Philadelphia, were employed to connect, by silver brazing, 20 and 40 ft lengths of 1¼-in. galvanized wrought-iron pipe. Of about 6,000 joints made, only 181 leakers were found. Majority of these were repaired by heating the pipe and fittings, and only three joints needed to be replaced.

Some 3½-in. of concrete was poured around the pipe and wire screen was embedded in this base to form a bond for the ¾-in. terrazzo bed. Finally a terrazzo top, also ¾-in. thick was laid, making a total of 1½-in. between the pipe and the finished floor.

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ERIE, PENNSYLVANIA

Engine-Driven Welders Given to Operating Engineers Union

OPERATION of engine-driven arc welders will be under the jurisdiction of the International Union of Operating Engineers (AFL), according to a November decision of the National Joint Board for the Settlement of Jurisdictional Disputes in the construction industry. The decision settles a jurisdictional dispute between the operating engineers and the Plumbing and Pipefitters' Union.

It is understood that William E. Maloney, president of the operating engineers, is advising union business agents and the AFL building trades that the union will not assert its jurisdiction over these engine-driven welders where there is only one on a job and it is rated less than 400 amp. The plumbers' union had testified that on 90% of its jobs, one welder is used.

The five-man board, headed by Harvard University professor John T. Dunlop, had to decide which of two precedents applied. The controversy arose on a job of the Turner Construction Co. at the Yale and Towne Co. plant in Philadelphia.

In favoring the operating engineers, the board held that the dispute is covered by Resolution 124 of the AFL convention of 1907. This resolution states that the engineers have jurisdiction over "the motive power of all derricks, cement mixers, hod hoists, pumps and other machines used on construction work."

Plumbers' and pipefitters' union had contended that since its members were doing the work on which the welding equipment was being used, its members hould operate the welder. This was based on a decision in 1937 of Dr. John A. Lapp, at that time national referee for the AFL Building and Construction Trades Dept. That decision held the operation of welders to be within the jurisdiction of the trade doing the welding. Plumbers had argued that if the welder is a tool of the trade then so is the engine that runs the generator to produce welding current.

Representatives of the heating, piping and air conditioning industry intervened on the side of the plumbers' union at hearings before the board in Chicago.

An argument against awarding jurisdiction to the operating engineers was that it might necessitate hiring an engineer to merely start and stop the engine, while a member of another union would have to operate the welder proper.

The board considered its function simply to apply existing jurisdictional rulings or make new ones when none is applicable. It did not consider it in its authority to examine the economic aspects of the dispute.

The board machinery was put into effect in May, 1948, in an agreement between the AFL Building Trades Dept., and a number of contractor associations whose members employ building trades workers. Contractors may utilize the plan if they are willing to accept the final decision as binding.

Previous decisions of the board have covered preheating and stress-relieving.

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About People

A. F. VINSON, formerly assistant production manager, G-E Apparatus Department, and chairman of the G-E Welding Committee, has been appointed manager of General Electric's Welding Divisions. C. I. MACGUFFIE, and R. C. FREEMAN have been named sales manager and manager of engineering, respectively, of the G-E Welding Divisions.

* * *

G. O. ROMIG is sales manager of the Cleveland plant of the Claud S. Gordon Co., Chicago.

* * *

J. NORMAN QUINLAN, division superintendent of the west mills of the Gary works of Carnegie-Illinois Steel Corp., has been named assistant to the general superintendent of the plant, the world's largest steel mill. Other executive changes are CHARLES J. HUNTER, who becomes division superintendent of the west mills; OSCAR PEARSON who will be chief metallurgist and inspector and RAGNAR OVERBERG who becomes assistant in steel production and central mills.

* * *

RALPH M. HOFFMAN, president of Link-Belt Co., Pacific Division, San Francisco, was recently elected a vice-president of the parent Link-Belt company at Chicago.

* * *

DR. LESTER M. GOLDSMITH, chief engineer of The Atlantic Refining Co. has been awarded the President's Certificate of Merit for outstanding wartime service. In April, 1947, he was presented the decoration for Exceptional Civilian Service for his contributions to the installation of an oil pipeline under the English Channel preceding the Normandy invasion—the famed "Operation Pluto."

* * *

H. J. FRENCH, vice-president of The International Nickel Co., Inc., New York City, presented the Woodside Memorial Lecture before the Detroit Chapter of the American Society for Metals in October. In 1940, Mr. French was honored for his contributions to the advancement of welding, for co-authoring that year's Lincoln Gold Medal award paper, "Weld Hardening of Carbon and Alloy Steels."

* * *

HERMAN C. PHELPS has been named sales manager of All-State Welding Alloys Co., Inc., White Plains, N. Y. R. J. MCCALLIAN is regional sales manager for the middle Atlantic states. Mr. McCallian is a member of the New York chapters of the American Welding Society and the American Society for Metals.

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PAUL E. MILLER and JACK R. KOSKE have been named regional sales supervisors for Eutectic Welding Alloys Corp., New York City. They will handle the mid east section and the east central section, respectively.

• • •

CHARLES B. CULBERT, JR. is located in the Boston area as company representative for Arcos Corp., Philadelphia. His offices will be at 16 MacArthur Road, Natick, Mass.

• • •

RONALD B. SMITH has joined the engineering staff of M. W. Kellogg Co., Jersey City, N. J. He is a consultant to the Atomic Energy Commission and a member of the National Advisory Committee for Aeronautics.

• • •

R. A. WERNSDORFER, service engineer for Black and Decker Mfg. Co., Towson, Md., has been transferred from the Atlanta branch to the Baltimore branch office.

• • •

ORVILLE F. FIGLEY has been named manager of the Chicago district of the United States Steel Supply Co. Assistant district managers are FREDERICK L. BRUCKNER and ARTHUR W. JOHNSON.

• • •

WILLIAM J. McGRAW has been appointed manager of the Cleveland branch of the Independent Pneumatic Tool Co., Aurora, Illinois. He will be succeeded in his present capacity as manager of electric tool sales in the New York territory by ED B. ROSELL.

• • •

JOHN M. JAYCOX is the new chief engineer of the Gary works of National Tube Co. He is a graduate of Carnegie Institute of Technology.

• • •

ROBERT H. MORSE, JR., vice-president of Fairbanks, Morse & Co., and LUDWIG SKOG, senior partner of Sargent & Lundy, Chicago consulting engineers, have been elected to the board of trustees of Illinois Institute of Technology at Chicago.

Died

EUGENE T. SCOTT, 35, former sales manager of Templeton, Kenly & Co., Chicago, manufacturers of Simplex Jacks, died on September 30 at his home in Hinsdale, Ill.

• • •

DR. WILLIAM ROTH WORK, 67, Assistant Director of the College of Engineering and Science, Carnegie Institute of Technology, died on October 3 in Pittsburgh. Dr. Work was a Fellow of the American Institute for the Advancement of Science; a member of the American Institute of Electrical Engineers, American Society for Engineering Education, the Engineers' Society of Western Pennsylvania and the American Association of University Professors.

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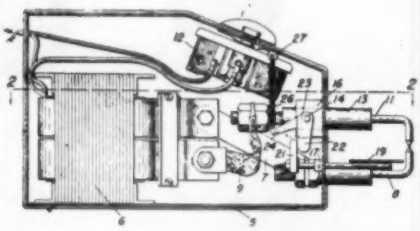
From the Patent Office

Bench Welder

2,448,865. Nicholas Crombach, San Francisco, Calif. Filed May 16, 1947. Issued Sept. 7, 1948.

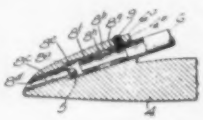


This patent refers to a small welder suitable for dental work comprising a casing, a welding transformer positioned in the casing and a pair of electrodes mounted in the casing. One of the electrodes is stationary, the other is pivoted. A pivoted arm is mounted parallel to the stationary electrode. A plate (19 in figure) is secured to the arm and a pusher secured at its opposite end which engages a bell crank lever. The bell crank lever is connected to the pivoted electrode, and spring means maintains the bell crank lever in engagement with the pusher. Downward movement on the plate will cause the pusher to move the bell crank lever and its attached electrode away from the stationary electrode.

* * *

Soldering Iron

2,447,110. Frank C. Bitzenburger, Los Angeles, Calif. Filed May 15, 1944. Issued Aug. 17, 1948.



In a soldering iron, a soldering element has a longitudinal tubular passage in it. The passage extends to near the soldering end of the element. Intermediate the forward and rear portions of the passage is an enlargement. The forward end of the rear portion of the passage extends forwardly of the rear end of the enlargement. This forms an undercut recess backwardly from the forepart of the rear portion of the passage. The enlargement is so constructed and arranged with respect to the passage as to retard outward flow of melted solder and prevent backward flow.

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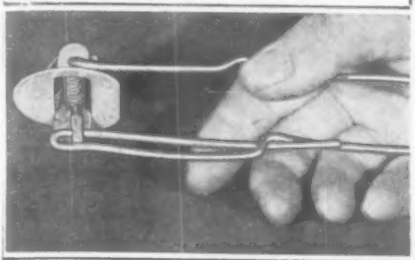

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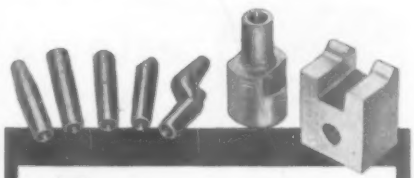

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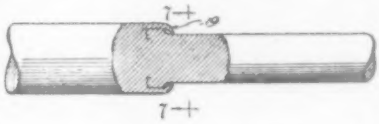
Flash Welded Joint

2,447,085. William H. Odlum, Wilmette, Ill., assigned to Duro Metal Products Co., Chicago. Filed May 11, 1944. Issued Aug. 17, 1948.

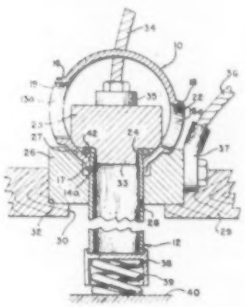


This patent pertains to the method of end joining two solid bar members of different sizes. The end of the larger member is hollow milled to provide a central protuberance and a surrounding wall spaced from it extending outwardly beyond the protuberance to define a channel and adjoining opening larger than the end of the smaller member. The end of the smaller member is moved into the opening to abut with the protuberance without contacting the wall. Welding current passes between the protuberance and smaller member as they are pressed together. The welding flash is confined to the inner portion of the opening away from the ends of the wall. The flash is concealed by forming the end portion of the wall inwardly to the surface of the smaller member.

* * *

Electric Brazing Method

2,448,329. Frank W. Schwinn, Chicago, Ill. Filed Apr. 5, 1946. Issued Aug. 31, 1948.



Patent pertains to a method of securing together two tubes in angularly disposed relationship. A side opening is provided in one of the tubes and the metal extruded adjacent the opening to a predetermined diameter to form an outwardly projecting flange at the edge of the opening. End portion of the other tube is tapered to fit tightly into the enlarged opening so that its end margin projects linearly into the other tube. Tubes are positioned with the end margin upright. Within one tube and around the inwardly projecting end margin of the other a ring of solder is placed. When the solder is melted by electrically heating adjoining portions of the tubes, the solder flows into the space between the tubes.

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EASIER TO SEE THROUGH!
And they OUTLAST OTHERS 10 to 1

Write your name and address in the margin of this page and mail it to us . . . or send a letter. We'll send you sample glasses to test. You'll see in a hurry why Navy Yards, Shipbuilders, etc. used Bullock Glasses by the millions during the war.

Bullock Cover Glasses are coated on both sides. They last longer because their coating protects them against splatter, moisture, heat breakage. They stay clear, clean, uncracked 10 to 20 times longer. One Bullock Glass will last for days . . . no time out for changing . . . no blurred vision . . . no eyestrain. Tear this out now and mail it.

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15c each
100 for $12.00
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WITH THE NEW
HARGRAVE "41 WELDERS' CLAMP

Spatter doesn't matter with the new Hargrave No. 41 Welders' Clamp. The No. 41 Welders' Clamp features a patented solid alloy screw that permanently resists spatter. Clamp has been designed with the aid of welding engineers and operators. Frame is of forged steel, heat treated for maximum strength and long life. Each clamp is *Individually Tested*. The No. 41 Regular Service Welders' Clamp is manufactured in 2, 4, 6, and 8 inch openings. Also available in Heavy Service pattern. (No. 43 Heavy Service Welders' Clamp) in 4 to 12 inch openings.
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1944 Waverly Ave.
Cincinnati 12, Ohio
The Cincinnati Tool Co.

THERE IS AN INDUSTRIAL DISTRIBUTOR STOCK NEAR YOU

R-W Control

2,438,490. James Leslie Ashford and William Alfred Billings, London England, assigned to mesne assignments, to International Standard Electric Corp., New York City. Filed June 22, 1943, in Great Britain July 31, 1942. Issued Mar. 30, 1948.

This system consists of a pair of electrodes, a source of voltage, transformer means having a primary winding connected across the source and a secondary winding connected across the electrodes to produce a voltage. When the electrodes are open, a relay having contacts connects source and primary winding, and an armature opens the contacts when energized. In order to produce an electromagnetic field the armature is energized in response to the source voltage with means for producing another electromagnetic field opposing the energizing field in response to the electrode voltage to de-energize the armature and to open the contacts. When fusion at the weld takes place, the relay has a coil for energizing the armature. This coil includes a second transformer means having a primary winding across the electrodes and a secondary winding in series with the coil.

NEW PRODUCTS

(Continued from page 85)

Rocker-Arm Spot Welders

Improved air-operated rocker-arm welders in 30 and 50 kva capacities and with throat depths ranging from 18 to 36 in. are being made by Progressive Welder Co., 3050 E. Outer Drive, Detroit 12.

Important features are: three independent water cooling circuits for transformer; optional single-operating cylinder or compound retractable-stroke cylinder; transformer directly coupled to welding arms and supported from rigid front column of machine; compact air line accessory group mounted within machine but visible through opening in side panel; self-lubricating bearings; high speed air valve; water and air systems piped to the rear of machine to facilitate installation and maintenance.

* * *

Scaling Hammer

Removal of splatter and excess metal after welding, general scaling, peening and beading are among the functions of a new scaling hammer, "Master Model" M-205 and M-206. Model 205 is 8¼ in. long, has a 1-in. bore, 1⅛-in. stroke and weighs 3¼ lb without chisel.

Features include: simplified design; lower air consumption; easy feather of control in both lever and push-type throttles; "sure-grip" body contour; self-seating valve; locking-device of back head that keeps valve mechanism sealed against air leakage and dirt. Master Pneumatic Tool Co., Orwell, O.

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Simplex UTIL-A-TOOL

clamps, pulls, pushes, spreads, bends or lifts

The Simplex Util-A-Tool pulls together, clamps and holds parts of all sizes and shapes. Easy to use and powerful, it saves time and work. Handy, too, as a jack, as a puller or for pressing. Set includes Util-A-Tool, sky hooks, 3-way base, spreader jack, chains and lever bar.

Simplex Lever Screw Hydraulic Jacks

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1000 S. Central Ave., Chicago 44, Ill.

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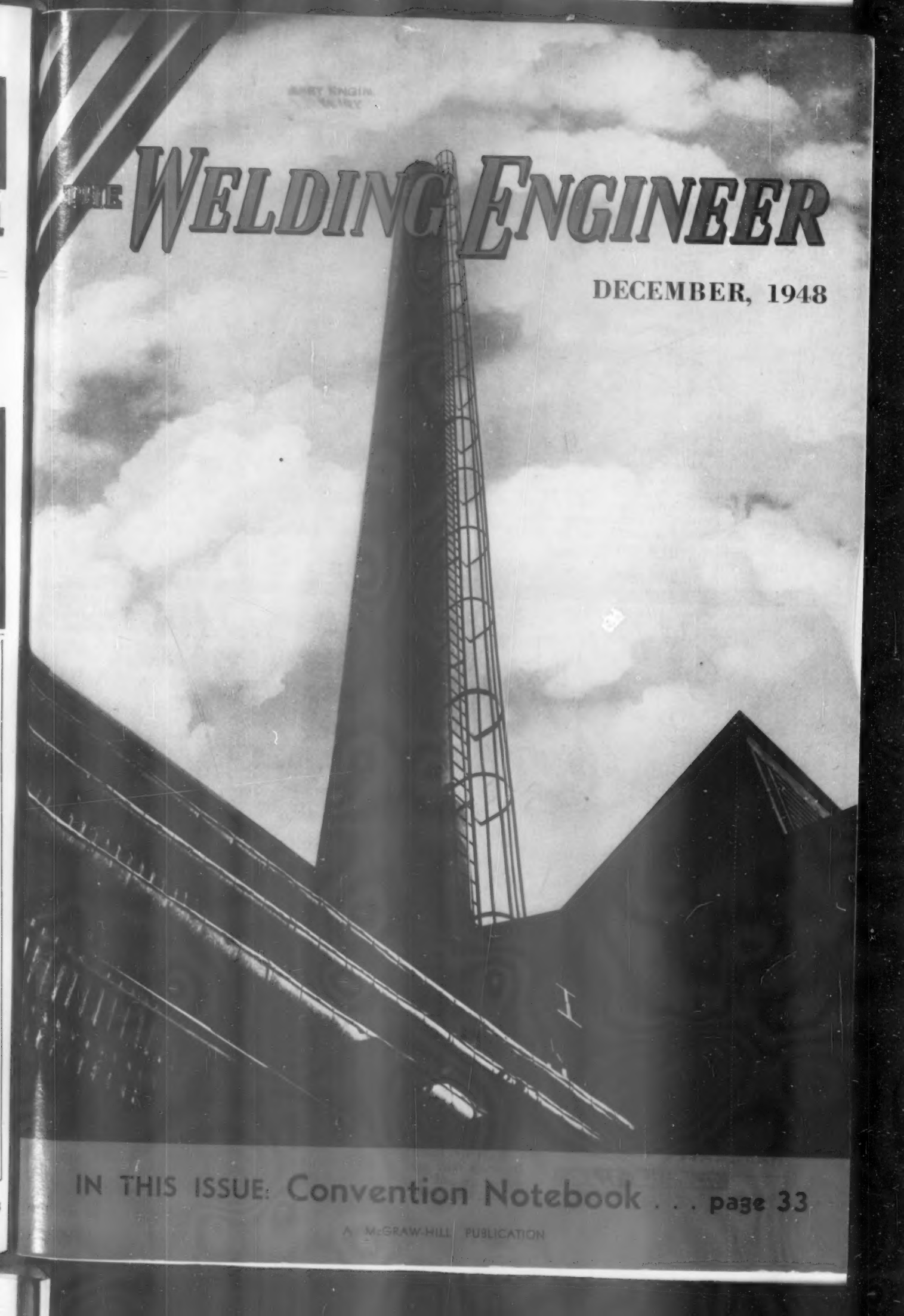

THE WELDING ENGINEER

DECEMBER, 1948

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A McGRAW-HILL PUBLICATION

JACKSON

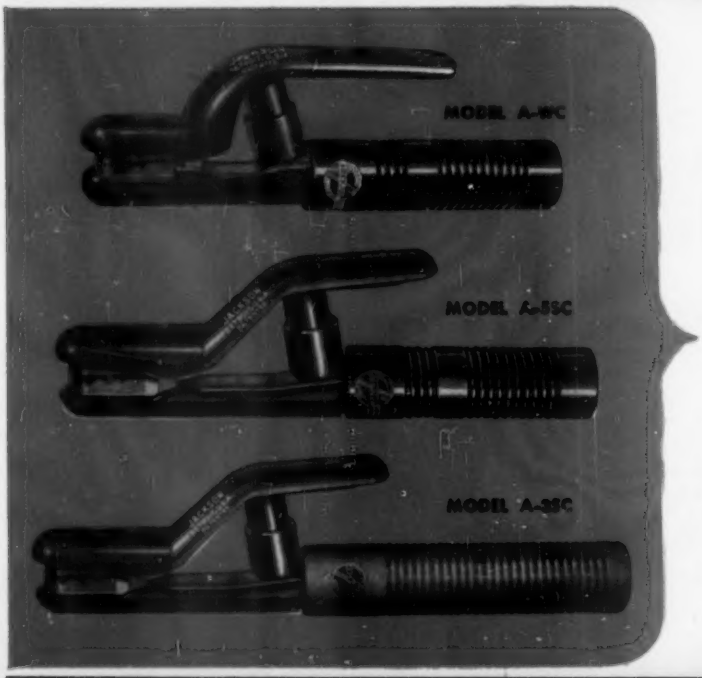
Featherlight

HOLDERS WITH REPLACEABLE JAWS

For those long hours of work in an overhead position, (or in any position at all), these *Featherlight* holders are great to lessen fatigue. No wonder the Jackson A-W, lightest insulated holder to take ¼-inch rods, is the most popular in our line. Light metal alloy parts on Featherlight models reduce weight 36%. Jaws of Mallory 3 metal may be easily replaced. Mechanical cable connection.

A-W, electrodes through ¼" • 300 Amps • 9¾" long • 14 oz.

A-3S, electrodes through 5/16" • 400 Amps • 11⅛" long • 21 oz.



JACKSON

FORGED COPPER ALLOY

HOLDERS WITH REPLACEABLE JAWS

These three models have tongs made entirely of forged copper alloy. A-WC and A-5SC are otherwise identical to the Featherlight holders. All feature the same improved pivoting device for easier servicing, the same replaceable jaws for longer life. Like all insulated Jackson holders, the new jaw insulators are three times stronger. Cable connection mechanical, soldered, or brazed.

A-WC, electrodes through ¼" • 300 Amps • 9¾" long • 26 oz.
A-5SC, electrodes through 5/16" • 400 Amps • 11⅛" long • 33 oz.
A-3SC, electrodes through ⅜" • 500 Amps • 13⅛" long • 36 oz.

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